

HANDBOOK OF
YOSEMITE
NATIONAL PARK



COMPILED AND EDITED
By
ANSEL F. HALL

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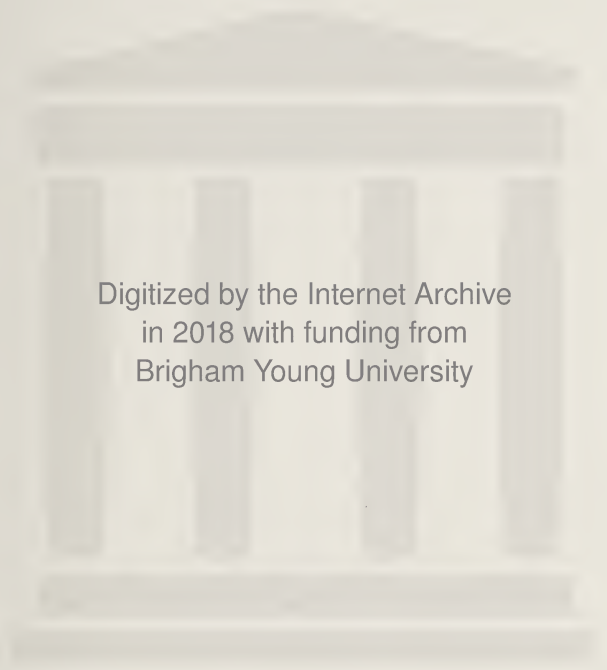
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with the sincere
good wishes
of

Ansel F. Hall.

Yosemite Valley,
July 31, 1923.





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PLATE I

Yosemite Valley from Old Inspiration Point. The view which greeted the men of the Mariposa Battalion on March 21, 1851 when they entered this valley of Awahnee

Photo by A. C. Pillsbury

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HANDBOOK OF YOSEMITE NATIONAL PARK

A COMPENDIUM OF ARTICLES ON THE
YOSEMITE REGION BY THE LEADING
SCIENTIFIC AUTHORITIES

COMPILED AND EDITED BY

ANSEL F. HALL

U. S. NATIONAL PARK SERVICE,
FORMERLY INSTRUCTOR IN FORESTRY, A E F UNIVERSITY,
BEAUNE, FRANCE.

ILLUSTRATED

G. P. PUTNAM'S SONS
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To My
COMRADES OF THE
NATIONAL PARK SERVICE

INTRODUCTORY NOTE

YOSEMITE NATIONAL PARK needs no introduction to the American public. Much has been written in appreciation of "The Valley Incomparable" and of the eleven hundred square miles of scenic High Sierra which have been set aside as a playground for the people.

Men like Le Conte and Muir were as "a voice crying in the wilderness" telling the outside world of the wonders of the region; others have written of its trails and its scenery; there still remains the task, however, of satisfying the thousands who now ask for definite information concerning the history, ethnology, botany, geology, camp- and trail-craft, natural history, and related subjects so well exemplified by the Park. Obviously no one man can be a master of all these branches of knowledge, so the Editor presents this collection of articles, each by an eminent authority.

Acknowledgment and sincere thanks are due to the scientists whose coöperation has made this volume possible. These contributors are so well known in their respective fields of science that they need no introduction. The Editor is indebted to many others who have supplied photographs and to Messrs. Herbert Maier and Duncan Dunning whose drawings appear as chapter headings.

This little volume is offered with the hope that it will point the way to the better understanding and the fuller enjoyment of the Yosemite region.

ANSEL F. HALL,
In Charge of Information,
Yosemite National Park.

January 1, 1921

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HISTORY

of the

YOSEMITE

REGION

By

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HISTORY OF THE YOSEMITE REGION

BY RALPH S. KUYKENDALL

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It is probable that the first white men to look upon Yosemite Valley were members of the Joseph R. Walker expedition of 1833, which descended the western slope of the Sierra Nevada along the ridge between the Merced and the Tuolumne rivers. But the best contemporary evidence makes it clear that this party did not go down into the Valley. There are vague reports of hunters having entered the Valley as early as 1844, but the effective discovery of the Yosemite was made in 1851 by members of the Mariposa Battalion while in pursuit of hostile Indians.

THE MARIPOSA INDIAN WAR

When white men flocked into the foothills of the Sierra in search of gold it was not long before difficulties arose with the Indians. On this frontier was repeated the old story of the red man's fight to keep possession of his ancestral home. The struggle was short, since the California Indians were not capable of maintaining a long contest. In this connection we are concerned with only that part of the struggle which is known as the Mariposa Indian War.

In the beginning of 1850, James D. Savage had a trading post and mining camp on the Merced River some twenty miles below Yosemite Valley, which was at that time unknown to the whites. During the spring of that year Indians came down the river and made an attack on this post. They were driven off, but Savage thought it best to abandon the place and remove his store to Mariposa Creek. He also established a branch post on the Fresno River and at both places built up a prosperous trade. Savage had several Indian wives and obtained quite a remarkable influence over the tribes with which he was connected. But there were malcontents among them and the tribes in the mountains were suspicious and easily incited to acts of hostility.

On December 17, 1850, Savage's Indians deserted the Mariposa camp and on the same or the following day his post on the Fresno was attacked and two of the three men there present were killed. Adam Johnston, the Indian agent, visited the place two days later and describes it as "a horrid scene of savage cruelty. The Indians had destroyed everything they could not use, or carry with them. The store was stripped of blankets, clothing, flour, and everything of value; the safe was broken open and rifled of its contents; the cattle, horses, and mules had been run into the mountains; the murdered men had been stripped of their clothing and lay before us filled with arrows; one of them had yet 20 perfect arrows sticking in him." Several similar outrages occurred soon after and signaled the beginning of a general Indian war.

Under these circumstances the white settlers took prompt action to protect themselves. Under the lead

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of Sheriff James Burney and James D. Savage, a volunteer company was formed, January 6, 1851, with Burney in command. This force had several indecisive skirmishes with the Indians. Meanwhile the governor was appealed to and he at once authorized Sheriff Burney to call out two hundred militiamen and organize a battalion for service as the emergency might demand. Under this authorization the Mariposa Battalion was formed February 10th, at Savage's partially ruined store on Mariposa Creek. Savage was elected major, and three companies were organized under command of Captains John J. Kuykendall, John Bowling, and William Dill. Headquarters were established on Mariposa Creek and here the battalion was drilled in preparation for the campaign, and occasional scouting forays were made into the enemy's country.

About this time the United States Indian Commissioners, McKee, Barbour, and Wozencraft arrived in California with instructions to make treaties with the Indian tribes. It was agreed that the commissioners would go at once to the disaffected region and endeavor to treat with the hostile tribes, and that the volunteer battalion which had been raised should be subject to their directions. If negotiations failed, force would be used to bring the Indians to terms. The commissioners arrived at the Mariposa camp about the first of March, and immediately sent out runners inviting the various tribes to come in and have a talk. A meeting was arranged for the ninth of March, and on the nineteenth a treaty was made with six tribes, which were at once removed to a reservation between the Merced and the Tuolumne rivers. The commissioners then went on to talk with the tribes

south of the Merced River, and left part of the volunteer battalion to deal with the Indians who had refused to enter into the treaty.

Among these were the Yosemite, and reports brought in by friendly Indians indicated that they had no intention of coming in to make peace. It was therefore deemed necessary to send a military force after them.

On the evening of March nineteenth, the very day on which the treaty was signed, Major Savage set out with the companies of Captains Bowling and Dill. "The march was over rugged mountains and through deep defiles covered with snows and was one of considerable exposure and hardship. . . . Part of the march was exceedingly difficult and dangerous. It lay along a deep canyon and a part of it had to be made through the water and a part over precipitous cliffs covered with snow and ice."

On the morning of the twenty-second, a Nuchu ran-cheria on the South Fork of the Merced River was surprised and captured without a fight. At this point a camp was established and messengers were sent ahead to the Yosemite with a request that they come into camp. Next day the old Chief Tenaya came in alone, and after an interview with Savage promised that if allowed to return to his people he would bring them in. Part of the tribe came in and Tenaya was sent with them to the camp on the South Fork.

DISCOVERY OF YOSEMITE VALLEY

In order to round up the remainder, Savage took one of the young braves as a guide and continued his march toward the north. Within a short time the

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company came to old Inspiration Point and the full view of the Valley was presented to their gaze. It must be confessed, however, that the scenic wonder of this valley made a very slight impression on these rough men of action, and without much ado they hastened down the trail and camped for the night on the south side of the Merced River, a little below El Capitan. The day of the discovery was March 25, 1851.

As the tired campaigners sat about the camp fire that night the events of the day were passed in review and the question arose of giving a name to the valley which they had found. Dr. L. H. Bunnell, upon whom the scenes and events of this campaign made a deeper impression than upon any of the others, suggested the appropriateness of naming it after the aborigines who dwelt there. The suggestion was agreed to after some good-natured banter, and since the white men called these Indians Yosemite the name Yosemite was given to the Valley.

The next day was spent in a search of the Valley, but no Indians were found save an ancient squaw who was too old and decrepit to make her escape. Indian huts, evidently deserted but a few hours before, and large caches of acorns and other provisions were found and destroyed. The Valley was thoroughly explored by the volunteers, one party going up Tenaya Creek beyond Mirror Lake and another ascending the Merced to a point above Nevada Fall. The search proving fruitless and the supplies running low it was decided to abandon the chase and return to the camp on the South Fork. From there the Indians who had been gathered together were started toward the commissioners' camp on the Fresno, but before they

arrived at their destination the negligence of the guard permitted them to escape and they returned to their mountain fastnesses.

SECOND EXPEDITION TO YOSEMITE

Early in May, Captain Bowling and his men were sent out a second time in pursuit of the Yosemitees. His orders from Major Savage were to "surprise them and whip them well," and in case that proved impossible then to use any means in his power to induce them to come down and treat. The following account of this expedition is quoted from Captain Bowling's report in the form of two letters, one of which is beyond any question the first letter ever written in the Yosemite Valley. Writing from the "Yo-Semety Village, May 15, 1851," he says¹:

"On reaching this valley, which we did on the 9th instant, I selected for our encampment the most secluded place that I could find, lest our arrival might be discovered by the Indians. Spies were immediately dispatched in different directions, some of which crossed the river to examine for signs on the opposite side. Trails were soon found, leading up and down the river, which had been made since the last rain. On the morning of the 10th we took up the line of march for the upper end of the valley, and having traveled about 5 miles we discovered five Indians running up the river on the north side. All of my

¹ The following authentic account was recently found by the author in the San Francisco *Alta California* for June 12 and 14, 1851, and differs in some details from the narratives presented in Bunnell's *Discovery of the Yosemite* and Hutchings' *In the Heart of the Sierras*. Editor's note.

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companions, except a sufficient number to take care of the pack animals, put spurs to their animals, swam the river and caught them before they could get into the mountains. One of them proved to be the son of the old Yosemite chief. I informed them that if they would come down from the mountains and go with me to the United States Indian commissioners, they would not be hurt; but if they would not, I would remain in their neighborhood as long as there was a fresh track to be found; informing him at the same time that all the Indians except his father's people and the Chouchillas had treated. . . . He then informed me that . . . if I would let him loose with another Indian, he would bring in his father and all his people by twelve o'clock the next day.

"I then gave them plenty to eat and started him and his companion out. We watched the others close, intending to hold them as hostages until the dispatch-bearers returned. They appeared well satisfied and we were not suspicious of them, in consequence of which one of them escaped. We commenced searching for him, which alarmed the other two still in custody, and they attempted to make their escape. The boys took after them and, finding they could not catch them, fired and killed them both. This circumstance, connected with the fact of the two whom we had sent out not returning, satisfied me that they had no intention of coming in. My command then set out to search for the rancheria. The party which went up the left toward Canyarthia [?] found the rancheria at the head of a little valley, and from the signs it appeared that the Indians had left but a few minutes. The boys pursued them up the mountain on the north side of the river, and when they had

got near the top, helping each other from rock to rock on account of the abruptness of the mountains, the first intimation they had of the Indians being near was a shower of huge rocks which came tumbling down the mountain, threatening instant destruction. Several of the men were knocked down, and some of them rolled and fell some distance before they could recover, wounding and bruising them generally. One man's gun was knocked out of his hand and fell 70 feet before it stopped, whilst another man's hat was knocked off his head without hurting him. The men immediately took shelter behind large rocks, from which they could get an occasional shot, which soon forced the Indians to retreat, and by pressing them close they caught the old Yosemite Chief, whom we yet hold as a prisoner. In this skirmish they killed one Indian and wounded several others.

"You are aware that I know this old fellow well enough to look out well for him, lest by some stratagem he makes his escape. I shall aim to use him to the best advantage in pursuing his people. I send down a few of my command with the pack animals for provisions; and I am satisfied if you will send me 10 or 12 of old Ponwatchi's best men I could catch the women and children and thereby force the men to come in. The Indians I have with me have acted in good faith and agree with me in this opinion."

The account is continued in the second letter which was written May 29th at the camp on the Fresno River:

". . . Notwithstanding the number of our party being reduced to 22 men, by the absence of the detachment necessary to escort with safety the pack train, we continued the chase with such rapidity,

that we forced a large portion of the Indians to take refuge in the plains with the friendly Indians, while the remainder sought to conceal themselves among the rugged cliffs in the snowy region of the Sierra Nevada.

“Thus far I have made it a point to give as little alarm as possible. After capturing some of them I set a portion at liberty, in order that they might assure the others that if they come in they would not be harmed. Notwithstanding the treachery of the old chief, who contrived to lie and deceive us all the time, his grey hairs saved the boys from inflicting on him that justice which would have been administered under other circumstances. Having become satisfied that we could not persuade him to come in, I determined on hunting them, and if possible running them down, lest by leaving them in the mountains they would form a new settlement and a place of refuge for other ill-disposed Indians who might do mischief and retreat to the mountains, and finally entice off those who are quiet and settled in the reserve. On the 20th [of May] the train of pack animals and provisions arrived, accompanied by a few more men than the party which went out after provisions, and Pon-watchi, the chief of the Nuchtucs [Nuchu] tribe with 12 of his warriors.

“On the morning of the 21st we discovered the trail of a small party of Indians traveling in the direction of the Monos' country. We followed this trail until 2 o'clock next day, 22d, when one of the scouting parties reported a rancheria near at hand. Almost at the same instant a spy was discovered watching our movements. We made chase after him immediately and succeeded in catching him before he arrived at

the rancheria, and we also succeeded in surrounding the ranch and capturing the whole of them. This chase in reality was not that source of amusement which it would seem to be when anticipated. Each man in the chase was stripped to his drawers, in which situation all hands ran at full speed at least four miles, some portion of the time over and through snow ten feet deep, and in this four-mile heat all Ponwatchi gained on my boys was only distance enough to enable them to surround the rancheria while my men ran up in front. Two Indians strung their bows and seized their arrows, when they were told if they did not surrender they would be instantly killed.

“They took the proper view of this precaution and immediately surrendered. The inquiry was made of those unfortunate people if they were then satisfied to go with us; their reply was they were more than willing, as they could go to no other place. From all we could see and learn from those people we were then on the main range of the Sierra Nevada. The snow was in many places more than 10 feet deep, and generally where it was deep the crust was sufficiently strong to bear a man’s weight, which facilitated our traveling very much. Here there was a large lake completely frozen over, which had evidently not yet felt the influence of the spring season.¹ The trail which we were bound to travel lay along the side of a steep mountain so slippery that it was difficult to get along barefoot without slipping and falling hundreds of yards. This place appearing to be their last resort or place where they considered themselves perfectly secure from the intrusion of the white man.

¹ This was Tenaya Lake, named after the old chief.

In fact those people appear to look upon this place as their last home, composed of nature's own materials, unaided by the skill of man.

"The conduct of Ponwatchi and his warriors during this expedition entitled him and them to much credit. They performed important service voluntarily and cheerfully, making themselves generally useful, particularly in catching the scattered Indians after surprising a rancheria. Of the Yosemite, few, if any, are now left in the mountains. . . .

"It seems that their determined obstinacy is entirely attributable to the influence of their chief, whom we have a prisoner, among others of his tribe, and whom we intend to take care of. They have now been taught the double lesson—that the white man would not give up the chase without the game, and at the same time if they would come down from the mountains and behave themselves they would be kindly treated."

Altogether Captain Bowling's command spent about two weeks in the Valley on this occasion. The main purpose of the expedition having been accomplished, a return was made to the headquarters on the Fresno and the Indians were placed on the reservation. Tenaya, however, chafed under restraint and appealed repeatedly for permission to return to the mountains. Finally, on his solemn promise to behave, he was allowed to go back to the Valley, taking his immediate family with him. In a short time a number of his old followers made their escape from the reservation and were supposed to have joined him. No attempt was made to bring them back, and no complaint was heard against the Yosemite during the winter of 1851-52.

EXPEDITION OF 1852

On the 20th of May, 1852, a party of eight prospectors started from Coarse Gold Gulch on a trip to the upper waters of the Merced River. They had just entered the Yosemite Valley when they were set upon by a band of Indians and two of them, named Rose and Shurborn, were killed and a third badly wounded. The others got away and after enduring great hardships arrived again at Coarse Gold Gulch on the 2d of June. The same day about thirty or forty miners set out to punish the treacherous Yosemitees. This party found the bodies of the murdered men and buried them at the edge of Bridalveil Meadow, where their graves are still to be seen, but they were compelled to return without punishing the murderers.

The commander at Fort Miller being informed of these events, a detachment of Regulars under Lieutenant Moore was at once dispatched into the mountains. On arriving in the Yosemite Valley this expedition surprised and captured five Indians. Clothing said to belong to the murdered men being found upon them, they were summarily shot. The remainder of the Yosemitees with their old Chief Tenaya made their escape and fled over the mountains into the Mono country. Thither the soldiers pursued, but were unable to catch any of them. The party lost a few horses, killed by the Indians, explored the region about Mono Lake, discovered some gold deposits, and then returned to the fort on the San Joaquin by a route that led south of the Yosemite Valley. A diary of this expedition, published in one of the Stockton newspapers about the 1st of October, 1852, contains one of our earliest descriptions of Mono Lake and vicinity.

After the return of the expedition, a party of miners under the leadership of Leroy Vining, attracted by the reported gold discoveries, crossed over the mountains and established themselves on what came to be known as Vining's Gulch or Creek. (The name appears on the maps a little later as Lee Vining Creek and upon the present maps as Leevining Creek.)

DEATH OF TENAYA

Tenaya and his fellow tribesmen seem to have remained among the Monos until the summer of 1853, when they returned once more to Yosemite Valley. They repaid the hospitality of the Monos by stealing a number of their horses. This proceeding stirred the wrath of the Monos, and they determined to wreak vengeance upon their erstwhile guests. They put on their war paint and descended suddenly upon the Yosemitees while the latter were in the midst of a gluttonous feast. Old Tenaya had his skull crushed by a rock hurled from the hand of a Mono warrior and all except a handful of his followers were slain. The tribe was virtually exterminated, though a few of their descendants still survive.

EARLY DEVELOPMENT

In spite of the exciting events which have been related above, Yosemite Valley was little disturbed by the visits of white men for some years longer. The Californians of that day, and particularly those in the mining region, were on the whole very little interested in scenery. Early in 1855, however, one of the very meager descriptions of the Valley which had found its way into print came by chance

to the notice of J. M. Hutchings. Hutchings was at the moment laying plans for the publication of his *California Magazine*, and for that reason the mention of a waterfall a thousand feet high arrested his attention, and he resolved to investigate the matter.

Early in the summer Hutchings organized what may fairly be considered the first tourist party to visit the Yosemite, consisting of himself, Walter Millard, and Thomas Ayres, an artist. At Mariposa, a fourth member, Alexander Stair, joined the party. Some difficulty was experienced in the matter of a guide, but finally, through the assistance of Captain Bowling and some other members of the Mariposa Battalion, two Indians were found to perform that essential service, and in due time the party found their way into the Valley, where they spent, says Hutchings, "five glorious days in luxurious scenic banqueting." Upon their return to the settlements these men gave an enthusiastic account of their experiences. Hutchings wrote an article which was printed in the *Mariposa Gazette* of August 16th, and parts of which were quoted in the San Francisco *California Chronicle* of August 18th. A picture drawn by Ayres was lithographed and published soon after, and before the year was out two other parties made their way into the Valley.

In the same year the construction of the first trail into the Valley was begun by Milton and Houston Mann. It was completed the next year but did not prove a paying investment and was soon sold to the county of Mariposa and made free. The old Coulterville trail was opened within a year or two and the Valley thus made accessible from both north and south; but accessible by rather a hard and painful journey. As time went by roads approached ever



PLATE II

Tenaya Lake where the last remnant of the Yosemite tribe was captured by the Mariposa Battalion on June 5, 1851

Photo by A. C. Pillsbury

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nearer from various directions, but it was many years before they reached the floor of the Valley. In the early days it required fortitude as well as enthusiasm to make a trip to Yosemite, and travelers of that time have left us many accounts of their discomfoting experiences.

In 1855 the walls of a cabin were erected in the lower end of the Valley by a party of surveyors who were seeking water for the Mariposa dry diggings, but the first house actually completed was built in 1856-1857. Being severely damaged by snow, it was replaced in 1858 by a more substantial structure, which was kept as a hotel during the next decade by a number of different parties. Included in the number of these early Yosemite inn-keepers was the Longhurst whom Clarence King describes as a "weather-beaten round-the-worlder, whose function . . . was to tell yarns, sing songs, and feed the inner man," and whose flapjacks the same fascinating writer professed a reluctance to eat, because that would seem like "breakfasting in sacrilege upon works of art." In 1859 was completed the central portion of the building which later became known as the Hutchings House, the lumber all being hewed or sawed out by hand. It may be of interest to note that this building (the present Cedar Cottage) was the subject of the first photograph ever taken in Yosemite.

The first permanent resident in the Valley was James C. Lamon, who took up a preëmption claim in its upper end in the fall of 1859, built a cabin, and laid out a garden and orchard which became famous in after years. From 1862 he resided in the Valley both summer and winter until his death in 1876.

In the spring of 1864 J. M. Hutchings came to

Yosemite with his family, having purchased a claim and arranged to buy the building to which his name became attached. After his advent as a permanent resident Hutchings was for a decade the leading figure in the Valley's history. He was "mine host" to a large proportion of the people who visited Yosemite in that period, and while there is abundant evidence that as an hotel-keeper he was not an overwhelming success, we may, perhaps, assume that his hospitable enthusiasm compensated in some degree at least for the defects of his hostelry.

AN HISTORIC SAWMILL

In order to make necessary improvements in his establishment Hutchings erected a small sawmill near the Yosemite Fall, for the purpose of turning into lumber a lot of trees that had been thrown down by a windstorm some years before. This sawmill of Hutchings' has rather a higher claim to notice than is possessed by most such structures: for nearly two years it was operated by no less a personage than John Muir. Muir was then on the threshold of his career, engaged, in the intervals between his work as sawyer and guide, in gathering the data on which were based his glacial studies of the high Sierra and in forming that passionate attachment for the "Mountains of Light," which proved to be so significant a factor in his life as well as in the history of the region.

It was also the scene of the first meeting, in August, 1870, of two men whose names and memories will forever linger in these mountains—Muir and the elder Le Conte. The latter has described the meeting and set down his first impressions of Muir:

"To-day to Yosemite Falls. . . . Stopped a moment at the foot of the falls, at a sawmill, to make inquiries. Here found a man in rough miller's garb, whose intelligent face and earnest, clear blue eye, excited my interest. After some conversation discovered that it was Mr. Muir, a gentleman of whom I had heard much from Mrs. Prof. Carr and others. He had also received a letter from Mrs. Carr, concerning our party, and was looking for us. . . . I urged him to go with us to Mono. [Later in the day we] learned from Mr. Muir that he would certainly go to Mono with us. We were much delighted to hear this. Mr. Muir is a gentleman of rare intelligence. . . . He has lived several years in the Valley, and is thoroughly acquainted with the mountains in the vicinity. A man of so much intelligence tending a sawmill!—not for himself, but for Mr. Hutchings. This is California!"

It seems singularly appropriate that these two men should meet thus for the first time in the great temple of nature which both loved so well; and under such circumstances, Muir in the rough garb of a mill operator and Le Conte in the scarcely less rough garb of a mountain traveler. It was Le Conte's first summer in the Sierra, and Muir conducted him and his party over the route which he himself had traced out for the first time only a year before.

CREATION OF STATE PARK

During the first decade after the Valley was brought to general notice the desirability of setting it aside as a park became manifest. The danger that it would soon fall into private hands led Senator Conness of California, in 1864, to secure the passage by Congress

of an act granting to the State of California "the Cleft, or Gorge, in the Granite Peak of the Sierra Nevada Mountains . . . known as the Yosemite Valley," with the stipulation, however, that it should be held for public use, resort, and recreation and should be inalienable for all time.

By the same act the Mariposa Big Tree Grove, four square miles, was also granted to the State under the same conditions. The act further provided that the two grants should be managed by a board of commissioners consisting of the Governor and eight other persons appointed by him.

On September twenty-eighth Governor F. K. Low issued a proclamation naming Frederick Law Olmsted, Professor Josiah Dwight Whitney, William Ashburner, I. W. Raymond, E. S. Holden, Alexander Deering, George W. Coulter, and Galen Clark as commissioners, and warning all persons to desist from trespassing or settling upon either of the two grants. At the first session of the legislature thereafter a law was enacted, April 2, 1866, legally constituting the Board of Commissioners, making the necessary provisions for the control and administration of the trust created by the grant from the federal government, and making a small appropriation for the first two years.

ADMINISTRATION OF STATE COMMISSIONERS

The commissioners first named and those subsequently appointed were, as a whole, well selected, but circumstances conspired to defeat many of their best efforts. They had scarcely entered upon the discharge of their duties when they found themselves involved in a prolonged litigation. The settlers.

Hutchings and Lamon, who had made their homes in the Valley, refused to surrender their holdings upon the invitation of the Commission. After some fruitless negotiation a test suit was brought against Hutchings, which in the district court was decided in his favor. On appeal to the Supreme Court of the State the judgment was reversed, and on being carried to the federal Supreme Court the position of the Commissioners was fully sustained. But in the meantime Lamon and Hutchings had brought their case to the legislature, and that body, under the influence of a sympathetic agitation, passed a bill granting to each of them a tract of 160 acres in the Valley, subject, however, to the approval of Congress. That approval was never given, so that finally, in 1875, after a second legal action against Hutchings, the Commissioners found themselves in full and undisputed control, for the State, of the property which they had been appointed to manage. On their recommendation the legislature in 1874 appropriated \$60,000 to compensate Lamon, Hutchings, and two others for the loss of their claims in the Valley.

The Commissioners were unquestionably right in the position which they assumed, and we cannot dismiss this phase of the subject without remarking upon the service which they rendered to the State and the nation in thus pursuing the case to its final settlement in their favor. The extinguishment of private titles has been one of the most perplexing and difficult problems confronting the administration of the park, whether state or national. At the same time we cannot overlook the equities in the case of the settlers, nor forget the fact that Hutchings in this early period did more perhaps than any other one person to make

known to the world the beauties and the wonders of Yosemite.

This controversy resulted in the creation of a rallying point for all forces hostile to the park administration. The granting of a road privilege on the north side of the Valley furnishes another example of the difficulties constantly arising. In 1869 the Commissioners granted to certain parties interested in the Big Oak Flat route the exclusive privilege of extending a toll road to the floor of the Valley on that side. These parties having failed to carry out their agreement, the Commissioners in 1872 granted a similar exclusive privilege to the Coulterville and Yosemite Turnpike Company, who went to work at once and completed their road into the Valley June 17, 1874. After this privilege had been granted, the Yosemite Turnpike Road Company, representing the Big Oak Flat route, applied for the privilege of building a free road from the edge of the park into the Valley. This being denied by the Commission, the company appealed to the legislature, which gave it the right prayed for. This road also was completed in the summer of 1874, and in the following year the Wawona road was extended into the Valley.

The Commissioners were greatly handicapped by the litigation described and the hostility which it engendered; by the action of the legislature in overriding their decisions, in the cases above mentioned; by the fact that the public was generally indifferent except as it was aroused by the distressed appeals of adversely affected individuals; by the lack of funds with which to work; and to an important degree by the fact that there was no accepted park practice or policy to guide them. Opposition to the Commission

culminated in the legislative session of 1880, when the Commissioners were incontinently ousted from office by the action of the legislators and a subsequent decision of the Supreme Court of the State. A new law was passed and a new board appointed.

The new body signalized its entry into office by appointing as Guardian J. M. Hutchings, in place of Galen Clark who had held the office for the preceding fourteen years. This board profited to some extent by the experience of its predecessor, especially since the controversy over private holdings had been settled, but it also succeeded in doing many things which called forth sharp criticism. It was necessary to adopt a policy for dealing with such questions as the granting of hotel, carriage, and saddle-train privileges, the use that should be made of the meadow lands, and the kind of attention that should be given to the wooded areas—whether to cut and prune or to leave the brush and young trees to grow untouched; and the policy adopted was sure to displease someone.

Still, the new Commission was in much better position to do effective work than the old one had been, and the next decade saw important results accomplished—the roads and trails within the park lines were freed from the vexatious tolls that had before encumbered them; new roads and bridges were constructed within both the Yosemite grant and the Mariposa Big Tree Grove; a pretentious hotel, the Stoneman House, was erected near the upper end of the Valley, for which the legislature in 1885 appropriated \$40,000. The new hotel turned out to be an unprofitable investment, for, as it was not properly constructed, expensive repairs were necessary. The building was finally burned to the ground in the summer of 1896.

The remainder of the period during which Yosemite Valley and the Mariposa Grove remained under state control witnessed slow but steady development along all lines; and it also witnessed a more significant thing—the growth of a wider and more intelligent interest in matters affecting the park, which had an inevitable and healthy reaction upon the administration.

MAPPING THE YOSEMITE REGION

It is only in recent years that the vast alpine region to the north and east of Yosemite Valley has become generally known to tourists, though for many years before that it was familiar to many mountain lovers. The first white men who frequented this Yosemite *hinterland* were miners and shepherders and cattlemen. After them came the surveyors and then the soldiers of the republic to guard the mountain meadows and forests from the destructive forces at work. And lastly the tourists, at first in little groups at long intervals, but now in throngs, to see the glories of the mountains.

The first systematic reconnaissance of the Yosemite region was made by the California Geological Survey between 1863 and 1867. The first expedition, in 1863, covered in a general way the watershed between the Merced and the Tuolumne and the headwaters of those rivers. Their later expeditions were made directly as a result of the creation of the state park, first to survey its boundaries and secondly to gather data for the preparation of the maps and text of a book descriptive of the Yosemite region which was published by the California Geological Survey in 1868. It was in connection with these and other expeditions

of the State Geological Survey that Clarence King had the experiences so delightfully described in his book "Mountaineering in the Sierra Nevada." To this survey we are indebted for the names of many of the peaks, and for the first accurate maps of the region. The same area was covered in 1878-79 by a party of the Wheeler Survey in charge of Lieutenant M. M. Macomb. The definitive mapping of the region has, of course, been done by the United States Geological Survey, whose fine topographic maps are familiar to all mountain travelers.

THE TRAIL OF THE MINER

The trail of the miner is found everywhere in the Sierra Nevada. We have already seen that the discovery of Yosemite was a result of the mining advance into the foothills. Subsequently there were two well defined periods of mining excitement which were of importance in the history of the region. The first of these began about 1857 when placer gold was discovered in what are broadly referred to as the Mono diggings. To accommodate the miners and pack trains passing to and fro across the range the Mono Trail was blazed out easterly along the ridge between the Merced and the Tuolumne, following in the main old Indian trails, and descending into the Mono plain through the steep defile of Bloody Canyon. For a few years this trail was much traveled and then fell into disuse as the placers were worked out. When Joseph Le Conte passed over it first in 1870 he found it nearly obliterated in many places.

The miners went elsewhere, but soon flocked back again in even greater numbers, when gold and silver

ores were discovered in the summit ridge about 1878. In a short time claims were staked out all the way from Parker Pass to Virginia Creek, but the interest centered principally at Lundy and Tioga. In 1881 a group of Eastern capitalists incorporated the Great Sierra Consolidated Silver Mining Company for the purpose of exploiting the central group of claims in the Tioga District. A post office, called Bennettville in honor of the president of the company, was established and operations were vigorously pushed. The writer has seen in a little paper published at Lundy a graphic description of the way in which the first machinery for the Tioga mine was snaked up the mountain side to Oneida Lake on skids, hoisted with a windlass to the summit of Tioga crest and thence dragged past Saddlebag Lake into Tioga in the dead of winter.

But this was too primitive a method to be used for bringing in all the heavy machinery and other supplies required. The company therefore determined to build a road up the western slope to Bennettville; and thus was inaugurated the building of the famous Tioga Road. The surveys were made in 1882 and construction work was begun in the fall of that year, Chinese labor being employed. The road was completed in the fall of 1883, having cost about \$62,000. In December, 1883, and January, 1884, toll franchises were granted by the counties of Mariposa and Tuolumne and for a short time tolls were collected from travelers who used the road.

Financial disaster overtook the company after it had expended over \$300,000 and the mine was closed in July, 1884. Subsequently, in January, 1888, the entire property, including the road, was sold by the Sheriff to W. C. N. Swift of New Bedford, Mass.,

who had been interested in the original company. In 1889 operations were resumed in the mine but were not long continued. The road, abandoned by its owners, year by year fell into disrepair.

It was during this period of mining excitement that John L. Murphy took up his claim on the shore of Lake Tenaya, built a cabin, and established a stopping place that was sometimes distinguished with the title of hotel. John B. Lumbert took up a claim in the Tuolumne Meadows which included the Soda Springs. For several years a saddle train was run during the summer between Lundy and Yosemite, and these places were connected by telephone. There was also the inevitable crop of rumors regarding projected railroads to cross the Sierras through this region. Finally it is to be noticed that in the summer of 1881 silver mineral was discovered near Mt. Hoffman and the considerable excitement occasioned by it resulted in the organization of the Mt. Hoffman Mining District. Some months later John B. Lumbert is said to have found a vein of silver bearing quartz in the Tuolumne Meadows. Sufficient quantities of ore have never been found to justify the working of these claims.

THE RÉGIME OF THE SHEEPHERDER

During all this time the Yosemite region was the haunt of the sheepherders and their all-devouring woolly charges. The mountain meadows are the finest of all sheep pastures, and year by year they were visited by countless thousands of these "hoofed locusts," as John Muir aptly termed them. As soon as the early summer heat dried up the grasses of the

plains and foothills the herds were headed toward the higher mountains, and before the autumn chill started them on their backward journey to the plains they had penetrated into every little grassy glade, leaving a desert in their wake, eating up or trampling to death every young plant that lay in their path, not excepting the young fir, which were for them an especially prized tidbit.

John Muir in his first summer in the Sierra noted the damage and destruction that was wrought by the sheep. The State Engineer, Wm. Ham Hall, in a report to the State Commission in 1882, called attention to the disaster threatening the Valley from the indiscriminate grazing of sheep in the Merced watershed. It was not alone the fact that the sheep ate up every green thing within their reach, or that their myriad trampling feet loosened the soil on the hillsides; the shepherd, through design or carelessness, applied the match, and "his trail to the plain was marked by the smoke of the burning forest."

CREATION OF NATIONAL PARK

The sheep may fairly be said to have been responsible for the formation of the Yosemite National Park. The first determined effort to protect the region surrounding the Valley from the destruction wrought by them was in 1881, when the State Commissioners fathered a movement to include in the state park a district somewhat smaller than the present national park. A bill embodying this plan was introduced into Congress but through the vigorous opposition of powerful local interests the success of the movement was frustrated. The Commissioners continued for

some years to urge the measure, but they were never able to muster sufficient influence to put it through.

In 1889, John Muir and Robert Underwood Johnson, one of the editors of the *Century Magazine*, camped together in Tuolumne Meadows. Muir pointed out to his friend the devastation that was being wrought by the sheep, and it was agreed, at Johnson's suggestion, that the way to save the region was to have it set aside as a national park. A plan of action was agreed upon—Muir to write for the *Century* a series of articles designed to arouse public sentiment, and Johnson to secure for the movement as much support as possible from influential men in the East. The movement thus launched culminated successfully in the enactment of a law, approved October 1, 1890, to set aside this region as "reserved forest lands." The name Yosemite National Park was somewhat inconsistently applied to it by the Secretary of the Interior. The original boundaries were larger than the present limits of the Park, including as they did a considerable area on the west and southeast which has been eliminated by subsequent legislation.

THE WORK OF THE SOLDIERS

The control of the Park was vested in the Secretary of the Interior, and the plan of administration adopted was to place the local authority in the hands of an Acting Superintendent, who was a military officer in charge of one or more troops of cavalry. The first Superintendent was Captain A. E. Wood, an intelligent and energetic officer, for whom the post at Wawona was later named. The soldiers ordinarily came in in April or May and took their departure in

October. During the winter two forest rangers patrolled the Park, so far as it could be patrolled.

The difficulties confronting the first Superintendent were rather formidable: the boundaries not having been surveyed were difficult or impossible to locate; the country to be patrolled was large and extremely rough; there was no well-planned trail system, and no detailed topographic map showing the location of such trails as did exist; it was necessary for the Superintendent to make himself acquainted with the region and to organize and direct a plan for protecting it from the encroachments of the sheep and cattlemen, who, having had undisturbed use of the Park for a quarter of a century, were extremely reluctant now to abandon it.

Headquarters were established at Wawona and from there patrols were sent out to cover the entire Park systematically. The principal work of these patrols was in fighting fires and in preventing trespassing within the Park lines by sheep and cattle. No penalty had been provided by Congress for the infraction of rules. The army officers ingeniously adopted the plan of driving the sheep from the Park and escorting the herders across the mountains to the opposite boundary. This plan when vigorously followed soon resulted in reducing this evil to a minimum. Besides these more general duties the soldiers frequently were compelled to repair trails and bridges along the line of their march. One Superintendent reports the clearing out and repair by the troop of more than sixty miles of trails in one season. The protection of the game within the Park from the depredations of predatory hunters was an important duty of the patrols.

These troopers were faithful and efficient. In the

discharge of their duties they not infrequently were called upon to push their way through snow-filled passes and to ford boulder strewn and angry mountain streams at flood water, sometimes in peril of their lives. One carries away from a perusal of the reports of the various Superintendents an increased respect for the military arm of the national government.

To the subordinate officers of the command there were frequent opportunities for special service. During the early years Lieutenants N. F. McClure, H. C. Benson, M. F. Davis, and W. R. Smedberg made a careful study of the topography of the region and from their notes and the results of previous surveys Lieutenant McClure prepared an excellent map for the use of the troops, on which the topography and the trails were accurately delineated. Lieutenant Benson spent several seasons in the Park, first as a junior officer and later with rank of Captain and Major as Acting Superintendent, and has always been keenly interested in all matters affecting it. It was upon his suggestion that the system of permanent patrolling stations was instituted in 1903. This greatly facilitated the work of the troopers. After a few years a telephone line was built connecting these stations with headquarters in Yosemite Valley, and thus instant communication could be had with all parts of the Park.

PLANTING TROUT IN YOSEMITE WATERS

Lieutenant Benson was an enthusiast on the subject of fishing and at all times took a lively interest in the stocking of the waters of the Park. Not only did he direct the planting of trout fry sent into the Park by the California State Fish Commissioners,

but he personally netted trout in a number of lakes and streams and placed them in unstocked waters.

This was a work of primary importance, since fish are not indigenous in any of the lakes or streams in the upper Yosemite region. John L. Murphy is said to have planted trout in Tenaya Lake in 1878, and about the same time the Yosemite State Commissioners took up the question of stocking the Yosemite streams. They proposed to have a hatchery established in the Valley. This plan, renewed from time to time, was not then carried out, but at their suggestion the State Fish Commissioners sent in young trout to be planted in the Merced River and its tributaries. After the establishment of the national park the planting of trout fry came to be one of the regular duties of the soldiers. In 1895, Washburn Brothers erected at Wawona a fish hatchery which was operated by the State Fish Commission, and from here millions of fry have been distributed in the lakes and streams throughout the Park. During 1919, the State Fish and Game Commission operated a temporary hatchery in Yosemite Valley under an agreement with the federal government. This work was not continued during 1920, but the last report of the National Park Service indicates that a permanent hatchery will soon be established in accordance with the agreement referred to.

REVISING THE BOUNDARIES

No sooner had the national park been created than efforts were begun to effect a change of boundaries. As first established, the Park included a large amount of land which was owned by private parties under patents and which was concentrated for the most



PLATE III

Liberty Cap and Nevada Falls. The buildings are the La Casa Nevada, a famous hostelry of the early days which has long since disappeared

Photo by George Fiske

part in certain relatively small districts. This was largely in the form of timber and mining claims. The owners very naturally objected to having their lands thrown into a national park with all of the inconveniences which that involved. There was also other supposedly valuable land of similar character within the Park lines which was not yet taken up, and this was now, by the terms of the law, withdrawn from entry.

From the standpoint of the administration of the Park there were two reasons for a change: first because of the trouble occasioned by the presence of privately owned lands within the Park; and second because the original boundaries were laid out along straight lines instead of conforming to the natural features of the country, and thus increased greatly the problem of a proper patrol system. For these reasons some of the early Superintendents advised reducing the size of the Park by fixing natural boundaries, so far as possible, and eliminating the bulk of the mineral lands and privately owned timber. Fortunately no attention seems to have been paid to their recommendations. Later Superintendents generally opposed cutting down the boundaries, but strongly urged the importance of extinguishing all private holdings within the Park by purchase or otherwise.

Within a few months after the Park came into existence an attempt was made in Congress to reduce its size. This first attack upon the integrity of the Park was defeated, largely through the efforts of the Sierra Club. As time went by it became clear that one of two things was necessary—either to buy up the private claims within the Park lines, or to revise the boundaries so as to exclude the bulk of these lands. The national government was evidently

unwilling to make the necessary appropriation to buy the claims, and finally in 1904 a commission appointed by the Secretary of the Interior visited the Park for the purpose of ascertaining, among other things, "what portions of said Park are not necessary for park purposes, but can be returned to the public domain." This commission, composed of Major Hiram M. Chittenden of the Engineer Corps of the army, R. B. Marshall of the Geological Survey, and Frank Bond of the General Land Office, made a careful study of the situation and recommended the boundary changes that were incorporated in the Act of Congress approved February 7, 1905. This act eliminated about twelve townships on the east and west and added about three townships on the north, fixing the eastern boundary at the summit of the Sierra Nevada and the divide between the Merced and the San Joaquin rivers. In 1906 another small tract on the southwest was cut off, ostensibly to enable an electric line to secure a right-of-way. All of these eliminated lands were added to the adjacent forest reserves.

Further changes in the boundaries may be expected. In fact the National Park Service in its recent reports has suggested the advisability of a further lopping off of grazing land on the west and the addition of a large area on the southeast (eliminated in 1905) which includes such scenic features as the Mount Ritter Range, Thousand Island Lake, and the Devil's Postpile.

RECESSION OF STATE PARK

The establishment of the national park resulted in bringing into existence a dual system in the Yosemite region, the State having control of Yosemite Valley

and the Mariposa Grove, and the national government having control of the surrounding territory. This was an awkward and inconvenient arrangement, necessitating much duplication of administrative machinery and expense. Yosemite Valley was the natural location for the headquarters of the national park, but could not be used for that purpose. Headquarters were therefore maintained at Wawona and the troops were constantly compelled to cross the state park lines in carrying on their patrol work. Superintendents repeatedly called attention in their reports to the anomalous situation and the difficulties which it involved. The disadvantage of dual control was sharply brought out in 1903 by a fire which burned for more than a week in the Illilouette basin, resulting in a rather ill-tempered controversy between the state and national park authorities over the questions as to where the fire originated and whether the state Guardian used due care and vigilance in its extinguishment. This division of authority interfered with the improvement and development of the entire region. The national government, not having control of what were considered the main scenic features, did not feel called upon to make large appropriations, and it was never possible to induce the State Legislature to set aside money enough to properly care for either Yosemite Valley or the Mariposa Big Tree Grove.

As time went by many citizens of California came to feel that it would be better to hand back to the national government the trust received from it in 1864, and a movement was launched with that object in view. It was pointed out that conditions had greatly changed since 1864, at which time there were no national parks; since then the federal government

had inaugurated a policy of creating national parks and had manifested a disposition to make adequate appropriations for their maintenance. A comparison of appropriations and results achieved in Yellowstone National Park and in Yosemite State Park proved a powerful argument. Many clubs and civic organizations were enlisted in support of the movement, chief among which in the zeal and effectiveness of its work was the Sierra Club.

Local state pride proved to be the greatest obstacle in the way of the recession, but this was finally overcome, and an act passed by the State Legislature, approved March 2, 1905, receding to the United States Yosemite Valley and the Mariposa Big Tree Grove. The adjournment of Congress prevented a formal acceptance of the recession until 1906 and hence the transfer could not be effected until that time. The Yosemite State Park finally came to an end August 1, 1906, after an existence of forty-two years. The Superintendent of Yosemite National Park, Major H. C. Benson, at once removed his headquarters from Wawona to the Valley and the central military camp was established on the site of the present Yosemite Lodge. In 1920 jurisdiction in all matters civil and judicial was transferred from the state to the national government.

THE SIERRA CLUB

One of the most important of the forces operating to shape the history of the Yosemite region since the creation of the national park has been the work of the Sierra Club. This organization has been instant in season and out of season in promoting all forward-looking movements affecting California's great alpine

heritage. The life of the Sierra Club has been almost exactly contemporaneous with that of Yosemite National Park. The Club was organized in 1892, but the idea from which it was evolved had its inception in the mind of Professor J. H. Senger of the University of California and was expressed by him as early as 1886. The final impetus was given to the movement by the strongly felt need of some organization to push forward the work that was only begun by the park act of October 1, 1890.

The special purposes of the Sierra Club are thus expressed in the articles of incorporation: "To explore, enjoy, and render accessible the mountain regions of the Pacific Coast; to publish authentic information concerning them; to enlist the support and cooperation of the people and government in preserving the forests and other natural features of the Sierra Nevada Mountains." A detailed account of the doings of the Club would show how faithfully and eagerly its members have carried out these purposes. During the first twenty-two years its work was carried on under the inspiring leadership of John Muir.

The field of the Sierra Club's work is much more extensive than the Yosemite National Park, but from the beginning it has taken a special interest in this region. Several of its annual outings have been held in the Park and surrounding territory. As early as 1898 a building in the Valley, granted by the State Commissioners, was equipped as local headquarters for the Club, to be used also as a public reading room and bureau of information. A few years later, after the death of Joseph Le Conte, the beautiful Le Conte Memorial Lodge was erected just below Glacier Point. In 1918 it was moved about a quarter mile westward to

its present site. In 1913 the Club purchased the Soda Springs property in the Tuolumne Meadows and two years later built upon it the E. T. Parsons Memorial Lodge.

The work of the Sierra Club in opposing attempts to cut down the size of the Park and in urging the recession of the state park has been referred to above. In every time of crisis the Club has stood forth as champion of the forests and the mountains against vandalism and commercialism. The *Sierra Club Bulletin*, an annual publication, contains a wealth of information about the entire Sierra region—descriptive, illustrative, and scientific. The speech and writings of its members have gone far toward making known to the wide public the true character of the Yosemite region.

HETCH HETCHY: EARLY HISTORY

This interesting counterpart of Yosemite was discovered in 1850 by a mountaineer named Joseph Screech. Not long before that the Valley was a disputed ground between the east and west slope Indians, but the Piutes from across the range had gotten the upper hand and for years were accustomed to spend some time in Hetch Hetchy in the fall of the year gathering acorns. Screech blazed a trail into the Valley and the rich meadow land became a grazing ground for sheep and cattle. Subsequently the discoverer and two or three other parties took up pre-emption claims covering most of the Valley floor. The State Geological Survey visited Hetch Hetchy in 1867, and a description of it was published in the *San Francisco Bulletin* in October of that year. When

John Muir first visited the Valley in 1871 he found a sheep owner named Smith in possession. This was doubtless the Smith who later obtained the ownership of a large part of the Valley and of several desirable tracts in the vicinity, and for whom Smith's Peak and Smith's Meadow were named. Muir records the fact that in the seventies Hetch Hetchy was frequently called Smith's Valley.

The number of tourists who visited Hetch Hetchy in the early days was very small, due to its inaccessibility and the superior attractions of Yosemite Valley. John Muir and other enthusiasts did much to acquaint the public with its beauties, but it was only after San Francisco started her fight to secure Hetch Hetchy as a reservoir site that it became widely known. Even then it was better known by report than by actual visitation. The Sierra Club included it in several of its annual outings. In 1905 some Stanford University students conducted a hotel camp there, under the auspices of the Santa Fé railroad, and that served to bring in a number of tourists.

HETCH HETCHY: THE SAN FRANCISCO WATER SUPPLY

The San Francisco city charter which was adopted in 1900 placed on the supervisors and the city engineer the duty of conducting investigations to determine the best available source for an adequate water supply for that city, this being a matter of pressing importance. After a careful examination of some fourteen suggested sources the Tuolumne River was selected as in every way the best, and there was prepared the first draft of what came to be known as the Hetch Hetchy project, the central feature of the plan

being the conversion of Hetch Hetchy Valley into a lake-reservoir and the use of Lake Eleanor as a secondary storage basin. The necessary filings were made to cover the desired water rights and an application was made to the Secretary of the Interior, under the provisions of the act of February 15, 1901, for a permit to use the proposed reservoir and for authorization to construct the necessary dams and other works.

As soon as the plans of San Francisco became known, a movement was put under way to prevent their consummation. This was the beginning of an extraordinary contest, lasting for a dozen years, which was at times waged with considerable bitterness.

San Francisco's first application was denied in 1903 by Secretary of the Interior E. A. Hitchcock. It was renewed in 1905 and again denied. In 1907, after James R. Garfield became Secretary of the Interior, the matter was presented to him, and a hearing was held in San Francisco in July of that year. Further arguments were presented in writing after the Secretary's return to Washington. Finally, on May 11, 1908, Mr. Garfield granted to the city the rights asked for, but upon two conditions: one that the Lake Eleanor site should be developed to its full capacity before any work should be undertaken on the Hetch Hetchy site; the other that the rights of the Modesto and Turlock irrigation districts should be fully protected.

Under the terms of this grant the city proceeded to buy up the private claims involved, at a cost of several hundred thousand dollars, and to vote a bond issue of \$45,000,000. Construction operations had been started when Secretary of the Interior R. A. Ballinger, in February, 1910, after an investigation of

the question, ordered the city to show cause why Hetch Hetchy Valley should not be eliminated from the permit granted by Secretary Garfield. This looked at first like a blow to San Francisco's plans, but it turned out to be quite the reverse, for the fight which was now inaugurated resulted finally in a complete triumph for the city and in the defeat of those who were trying to save Hetch Hetchy from inundation.

A board of army engineers, consisting of Col. John Biddle, Lieut.-Col. Harry Taylor, and Maj. Spencer Cosby, was appointed to advise the Secretary of the Interior on the question. After a preliminary hearing in May, 1910, a continuance of one year was granted in order that a thorough investigation might be conducted. The city hired one of the best engineers in the country and spent over a quarter of a million dollars in an examination of every phase of the question and in the preparation of the reports and plans on which its case finally rested. The final hearing was held November 25-30, 1912, before Secretary of the Interior Walter L. Fisher. The report of the advisory board of army engineers, presented February 19, 1913, was on the whole distinctly favorable to the city. Nevertheless Secretary Fisher declined to act on the matter, since he was about to retire from office and since he also felt that a question of such importance should be passed upon by Congress. Franklin K. Lane, who succeeded Mr. Fisher as head of the Interior Department, in view of his former connection with the case as city attorney of San Francisco, likewise referred the matter to Congress, and the fight was accordingly transferred to that body.

In June, 1913, as an emergency measure, Congressman John E. Raker introduced a bill granting to San Francisco the necessary rights and authorizations for carrying out the Hetch Hetchy water project substantially in the form presented in the plans prepared for the city by John R. Freeman. After extended hearings before the House committee this bill was redrafted in order better to protect the national park and to safeguard the interests of the government. In this form, in spite of the strenuous opposition of many persons from all parts of the country, the bill passed the House by a practically unanimous vote, passed the Senate by about two to one, and was approved by President Wilson, December 19, 1913. Under this act San Francisco was granted the immediate use of both Lake Eleanor and Hetch Hetchy Valley and the extensive engineering works called for by the development of the project were at once put under way. The city is required to build a scenic road along the north side of the lake that will be created by the flooding of Hetch Hetchy Valley, and certain other roads and trails the effect of which will be to make more accessible to tourists the country about Hetch Hetchy and the portions of the Park north of the Tuolumne River.

RECENT ADMINISTRATIVE CHANGES IN THE PARK

After the recession of the state park in 1906 the administrative machinery already established was continued in effect for some years longer, although the Acting Superintendent found himself confronted with much more exacting duties than formerly. In 1914 a new system was inaugurated. Secretary Lane

of the Department of the Interior, in his report for that year, says:

“The conditions in and around these reservations which led to the authorization of the use of the military force in these parks having radically changed, the conclusion was reached that their presence was no longer required in the Yosemite, Sequoia, and General Grant National Parks, and the Secretary of War was so advised. During the past year, therefore, troops have no longer been employed in these reservations and have been superseded by civilian rangers, bringing the latter in closer touch with the actual work of the park management than was formerly practicable when troops were only in the reservations for a few months.” The general plan of the patrol system begun under the military régime was continued by the civilian rangers.

Mark Daniels was the first Superintendent under the new arrangement. On March 10, 1914, he was “commissioned as landscape engineer in the Yosemite National Park for the purpose of preparing a comprehensive plan for the development and improvement of the floor of the Yosemite Valley covering the best locations for roads, trails, and bridges, so as to bring into view the full scenic beauty of the surroundings, the clearing and trimming of suitable areas of woods to provide attractive vistas, the proper location and arrangement of a village in the Yosemite Valley, etc.” An important step taken in 1915 was a change in the method of handling concessions, placing all the hotels, camps, and lodges (with the exception of Camp Curry) in the hands of one company under a long term lease, thereby providing for the building of two new hotels, one on the floor of the Valley and one at Glacier Point.

In June, 1914, Mark Daniels was appointed General Superintendent and Landscape Engineer for all the national parks under control of the Department of the Interior. This was as far as the executive branch of the government could go in the reorganization of national park administration. The final step awaited the action of Congress. For some years the Secretary of the Interior, seconded by the President, had been urging the establishment of a national park service. This was finally done by an act of Congress which was approved August 25, 1916. The new bureau was organized in the spring of 1917. As its first Director Mr. Lane appointed Stephen T. Mather, who had already, as assistant to the Secretary of the Interior, had general oversight of national park affairs. Much of the recent development in this field has been due to the clear vision, enthusiasm, and untiring energy of Mr. Mather. The establishment of the National Park Service marks the beginning of a new era in national park history.

THE NEW YOSEMITE

In the last decade a change has come over Yosemite—a change that can be fully appreciated only by those who have seen both the old Yosemite and the new. There has come into existence a new attitude on the part of the general public, and the administrative development just described is in part a cause and in part an effect of this new attitude. It is now seen that Yosemite is not simply the glorious valley of that name, nor the remarkable old Sequoias, but a vast alpine wonderland containing, besides these, many other features quite as much worth seeing.

There are several factors which have an important bearing upon this new conception, and it is necessary to mention a few of them.

The Park has been made accessible to a degree that was formerly only dreamed of or hoped for. First, the building of the Yosemite Valley Railroad has made it possible for the tourist to ride in comfort to the very edge of the Park, giving a much more effective approach to the Valley through the wild gorge of the Merced River. The building of this railroad was the final outcome of many suggestions and proposals for a wagon road or an electric road or a steam road designed to do away with the worst discomforts attending a visit to Yosemite. It follows the route which was pronounced the best by two different commissions appointed by the Secretary of the Interior. The right of way up the Merced River canyon was granted September 5, 1905, and the road was opened to travel in the spring of 1907. Second, the admission of automobiles has popularized the Park in a way that nothing else could do. This policy was inaugurated near the close of the 1913 season. At the present time approximately two thirds of the visitors to the Park enter it in private automobiles. Third, the rehabilitation of the Tioga Road has opened the great upper Yosemite region to thousands who would never have gone there under the old hard conditions. This road, the importance of which was stressed by every Acting Superintendent of the Park, was purchased and presented to the government in 1915 through the generosity of Stephen T. Mather and a few others. The State of California purchased the portions of the road outside of the Park and built an extension down Leevining Creek to connect with the highways on the

eastern side of the range, thus making this old road an important link in a great highway system. Fourth, the removal of the toll annoyance from the roads and the construction of new roads and trails within the Park have added immensely to the comfort of tourists and the ease of getting about to points of interest. The park road and trail system is not yet complete, but enough has been done to show beyond peradventure how richly it pays in the finer sense to open up the mountain playgrounds of the people.

Since the recession of the state park in 1906 and concurrent with the changes outlined above, travel to Yosemite National Park has increased thirteenfold and national appropriations have grown from a few thousand to \$300,000 for the season of 1920. With these changes the old Yosemite has become but a memory. The long hard trip over mountain roads followed by a sojourn in the quiet and restful Valley has given place to comfortable automobile and train service and life in modern camps and hotels. In winter, in early spring, and in late fall the Valley still bears much of its old-time restful atmosphere, but during the height of the season (July) the population numbers ten thousand or more. The policy of the National Park Service in making the Park "liveable" and more and more accessible is unquestionably the right one. Even now the charm of the old Yosemite can still be found by those who are willing to pursue it, for in Tuolumne Meadows, at Tenaya Lake, and at Merced Lake are delightful little mountain chalets; and in spite of further encroachments of civilization there will always be the wildness of nature for those who seek it.

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¹Only the most important works are listed in the references following articles in this volume. These include practically all of the non-technical literature now available on the various subjects.



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THE Indians of Yosemite belong to a group or family known as the Miwok who, before the white man came, owned the tract from the Cosumnes River on the north to the Fresno on the south, and from the crest of the Sierra Nevada to the edge of the San Joaquin Valley. The name Miwok is not strictly a tribal appellation; it is simply the word in the language of these Indians which means "people." In default of any specific designation for them, this term Miwok has been applied in distinction from other groups of aborigines. Of such groups, there may be mentioned as neighbors: the Maidu to the north in the Sierra; the Yokuts to the south in the foothills and to the southwest in the San Joaquin Valley; and the Mono to the south in the high Sierra, and to the east in Owens Valley and about Mono Lake. Excepting the Mono (who are an offshoot from the Paiutes and other Shoshoneans of Nevada and the Great Basin country) the other groups of Indians adjacent to the Miwok are very similar to them in physical type and customs, and even show a probable, although distant, relationship to them in speech. In short, the Miwok are typical and representative California Indians, and in this capacity

form part of the large body of tribes known as "Diggers." This is, however, a misleading name; partly because it carries a tinge of contempt, and still more because it lumps together a variety of nationalities that sometimes differed pretty thoroughly in their speech or were even unaware of one another's existence. For this reason the more accurate terms Miwok, Maidu, and Yokuts are preferable.

ORIGIN

The origin of these Sierra Nevada tribes is not definitely known. There can, however, be no serious doubt that they form part of the generic American Indian race and that their ultimate origin must be sought wherever the source of this division of mankind may have lain. While no one is yet in a position to speak dogmatically on this matter, all indications point to the Indians having come at some time in the far past from Asia, probably by the Bering Strait and Alaska route. It is clear that in his bodily type the Indian more nearly resembles the Mongolian of Eastern Asia than any other variety of the human species. The long, straight, stiff hair, one of the most valuable marks in race classification, is alone sufficient to establish a strong presumption in this direction. As to when this migration of the first inhabitants of America out of Asia took place, there is growing up a fairly unanimous concensus among anthropologists that this movement must have occurred at about the time that the Old Stone Age was giving place to the New in Europe; that is to say, in the period at which chipped stone tools were being replaced by polished ones, and the ax, bow and arrow, textiles, agricultural imple-

ments, and domestic animals were becoming part of the heritage of the species. These steps in advance are believed to have occurred about ten thousand years ago. We may therefore say roughly that somewhere about 8000 B.C.—with an allowance of a few thousand years either way as a margin for error—the American Indian became established on this continent and began his diffusion.

California was probably not very long in being reached; a mode of life adapted to local conditions was worked out, and with this the natives were apparently content, and their development progressed only slowly. They have left some traces of their occupancy in ancient village sites, shell mounds, and the like. Here the less perishable of their utensils, such as mortars, pestles, pipes, knives, arrow points, awls, beads, and other objects of stone, bone, and so forth, have been preserved. In one of the most favorable localities on the shores of San Francisco Bay careful computations have been made as to the age of these deposits, with the result that the lower levels of the shell mounds there have been estimated to date back at least 3000 years. The implements at these lower levels are ruder than those found near the tops of the mounds; but they are after all of the same type and even rather similar to those used by the modern Indians of the State, including the Miwok. We are therefore justified in assuming that native customs evolved very slowly in California, and that the ancestors of the Miwok and of the Yosemite Indians for a very long time past have lived very much in the manner and under the conditions in which they were discovered by the whites seventy years ago.

DECREASE OF NUMBERS

The Miwok probably numbered at least ten thousand, but the population decreased with terrifying rapidity after the advent of the white man. Some of the nearer groups of them were taken to the Franciscan Missions on the coast and there died off or became mixed with other tribes. The miner and rancher quickly overran the Miwok habitat after 1849. The Indian was crowded into the less desirable nooks; his native food supply was preëmpted; whiskey and new diseases against which he had no immunity were introduced and resulted in a startling mortality; and the general change in mode of life—new types of habitations, clothing, diet, labor, etc.—accentuated the effect of these diseases. The consequence was that in the sixty years between their first serious contact with the white man until the census of 1910, the Miwok lost more than ninety per cent. of their numbers. This census, which may not be wholly complete but was by far the most accurate ever made as regards Indians, enumerates only about seven hundred of them, and of these a fair proportion are mixed bloods. The number is still shrinking, but fortunately with less rapidity than formerly. The Indian has begun to adapt himself to civilized life, and has acquired some resistance to our diseases. The Miwok therefore bid fair to maintain themselves as a diminishing remnant for some time longer, and quite likely even a small fraction of them may survive permanently.

The Miwok were not divided into tribes in the usual sense of the word. They recognized very little political authority. They were broken up into small local groups, little larger than village communities, each of

which admitted the headship of some chief and allowed him a rather poorly defined amount of influence on their conduct. These numerous little bodies named each other, generally, after the localities which they inhabited. Thus the Yosemite Indians as a body were ordinarily known to the other Miwok as the Awanichi, after Awani, the largest or best known village site in the Valley, located not far from the foot of Yosemite Falls. In the same way a group south of Yosemite was called the Pohonichi, because in summer they ranged northward to the Valley in the region of Bridalveil Creek, the famous falls of which are known as Pohono.

FOOD: THE ACORN

The Yosemite Indians were in the hunting stage; that is, they never farmed nor raised domestic animals. Actually, however, only a small part of their diet came from game. They probably took as many pounds of fish each year as of animal flesh, and a still larger portion of their food was wild vegetable products. Among these the acorn was preëminent, and even to-day the caches or bins for the storage of these nutritious nuts can occasionally be seen in the Valley. These are rude affairs, eight or ten feet in height, constructed of brush much like a long and deep bird's nest, and set between four or five posts to keep the receptacle and its contents off the ground. They fulfill their function of food conservation with only moderate success, since one rarely approaches one of these caches without seeing a squirrel run out from a hole which it has wormed through the brush walls. Acorns, however, are plentiful in most parts of Cali-

ifornia and before the American introduced hogs they were superabundant, so that the Indians could afford to share part of their crop with these unbidden visitors and still have enough left for their own needs.

Acorns contain more or less tannin. The Indian women leached this out with hot water after the nuts had been shelled and pounded with a pestle in a stone mortar. The latter usually was nothing more than a hole in the surface of some convenient outcrop of granite. Frequently a number of these mortar holes were assembled in one spot; these were roofed over with branches, and in the shade of such an arbor the Indian women were wont to gather for hours at a time to wield the heavy pestle and meanwhile indulge in the gossip of which they were not less fond than their Caucasian sisters. After the acorns were pulverized, the meal was sifted and then cooked in baskets into a thin mush or gruel—the famous “acorn soup” which was the staff of life to most of the California Indians. As pottery and iron vessels were unknown, cooking had of necessity to be done in water-tight baskets. A basket cannot of course be set over a fire, so the Indian woman had perforce to bring the fire into her food, as it were. This she did by heating stones about the size of her fist, picking these up with a pair of sticks, and dropping them into the liquid, to which they communicated their heat until the mass boiled. The stones were then removed and the gruel was ready for consumption.

At least fifty to a hundred other varieties of food plants were utilized. Among the more important of these were buckeyes, which contain a narcotic poison that is removable by leaching like the tannin in the acorn; *chia*, a variety of sage the seeds of which can be



PLATE IV

Francisco, a Yosemite Indian, in dance costume. The crown is of magpie feathers, the headband of yellow-hammer feathers, and the white ropes about the body chiefly of eagle down. The kilt is a wild-cat skin with bead trimmings

Photo by J. T. Boysen

most palatably prepared; and brodiaëas, often called wild onions or lilies, whose bulbs were dug up by means of sharp sticks.

THE BOW: HUNTING AND WAR

The Miwok bow was from three to four feet long and had its back heavily covered with a layer of sinews to give added toughness and elasticity. It was a rather narrow weapon, and the sinew was thickened at the ends and then curled back on itself in a characteristic shape. Such at least was the bow used in warfare and for hunting large game. For rabbits, gophers, and birds, which can be approached closely, a ruder weapon without the sinew backing sufficed. For such purposes, too, the arrow was often a mere shaft, whereas the real hunting and war bow shot arrows which were foreshafted and tipped with delicate points of flint or obsidian. The latter material, a blackish, volcanic glass, the Miwok obtained by trade from the Mono Indians.

With all its inferiority to firearms, the bow is a powerful instrument within its effective range. A good weapon speeds an arrow with an initial velocity of 120 feet per second. It has definite killing power up to fifty yards, and at double that distance can easily inflict wounds that subsequently prove fatal. It tears the tissues more than a modern bullet, and frequently produces internal hemorrhages from which the victim bleeds to death, or which so weaken game that it can be followed up and overtaken. The longest attested flight for an arrow is more than a quarter of a mile, but this record was made with a composite Turkish bow and especial long range arrows. The

Indians never attempted shooting over such distances. They depended rather on knowing the habits of deer and elk and creeping up on them. A favorite device was for the hunter to cover himself with a deer hide and set on his head a stuffed deer's head. In this way he attracted the curiosity of his quarry without alarming it, and was often able to approach very close to it.

When the Miwok fought, which was not very often, it most frequently took on the form of a feud for revenge. They usually shot at each other at fairly long range; enough, at any rate, to make possible the dodging of arrows. Each line of warriors therefore capered and danced about to render it difficult for their opponents to take aim, and jerked forward and sidewise as they saw arrows coming. As might be expected, casualties were rather light. It was only when one party could ambush another, or pounce on a settlement asleep just before daybreak, that fatalities would run high.

HABITATIONS

The houses of the Yosemite and other Miwok Indians were rude affairs, built, according to location and abundance of materials, either of thatch, slabs of bark, or with a covering of earth. In Yosemite itself the cedar-bark house predominated. This was a conical lean-to with the slabs laid on several deep, and while not entirely wind-proof it afforded reasonable shelter. Most of the huts were small, probably not over ten or twelve feet in diameter. One or two of them may still be seen at the time of this writing, though they present rather a sorry appearance of gunnysacks, worn-out quilts, and pieces of sawn lumber mixed in with the bark slabs.

In the lower foothills, the native house was more frequently of the wigwam type, thatched with grass, rushes, or brush; and in parts of the San Joaquin Valley the earth lodge was typical. This was more or less excavated and covered with a heavy layer of earth laid on a roof of poles and brush supported by stout timbers. The Miwok used the earth lodge mainly for their dance- and sweat-houses. The former were large affairs up to forty or more feet in diameter. The latter were much smaller edifices in which the men daily sweated themselves for their health and physical comfort. The Yosemite Indians were about at the edge of the habit of building earth-covered dance houses. The more northerly Miwok and the tribes beyond used them regularly in every village of any consequence, whereas the Yokuts, to the south of Yosemite, did not erect earth lodges.

THE NAME YOSEMITE

The word "Yosemite" means Grizzly Bear in the Miwok language. Its more exact form is "üzūmati" or "ühūmati." The name became definitely attached to the Valley, and to the band of Indians that made it their headquarters, from the time of their first contact with Americans. There are several explanations. One story has it that an unarmed young Indian fought off a fierce grizzly bear with only a stick, and that this exploit led to the adoption of the name as a sort of heraldic crest by his group. Somehow this legend gives the impression of white man's imagination; it does not have the true ring of Indian tradition. Another account is that Tenaya (who was the chief of the Yosemite band at the time of the discovery and

whose name is perpetuated in that of the canyon leading into the Valley) and his people lived in a country infested with bears. In addition, the band was reputed to consist of unusually fierce warriors. Therefore the sobriquet "Grizzlies" was bestowed upon them by the neighboring tribes. This story also does not seem wholly in accord with known principles of Indian nomenclature; although Dr. C. Hart Merriam says that the inhabitants of Hokokwila, the native village where the Sentinel Hotel now stands, were called "Yohamite," that is, "Ühümati" or Grizzly Bear. The true explanation of the name of the Valley is probably to be found in a peculiar social institution which the Yosemite Indians shared with the other Miwok.

This entire nation is everywhere divided into two groups or "moieties" or halves, as we might call them, which intermarry. The first social law of these Indians is that a man must always take to wife a woman from the other moiety. The children follow the father, and whether boys or girls are restricted in their choice of wife or husband to the second moiety, that of their mother. In this way the lineage is carried on uninterruptedly generation after generation.

These two intermarrying halves of the Miwok nation have the elements land and water as their designations or totems, and are known as Tunuka and Kikua. The division is made more picturesque by assigning every known species of animal and plant to one or the other division. Thus the bear and most land animals and birds belong to the land side. Fishes, water animals, and plants and a few exceptional ones from the land—especially the deer and coyote—are

associated with water. In some parts of the Miwok country the people therefore speak of the "Blue Jay" and "Bullfrog" instead of the land and water divisions. In the Yosemite region it was customary to denominate the land side "Grizzly Bears" and the water side "Coyotes." Furthermore, within Yosemite Valley, all the villages on the north side of the Merced River were supposed to belong to the Grizzly Bear division, and those on the south the Coyote. It seems more than probable that this local name of one of these two sides or divisions came to be applied, through some misunderstanding on the part of the whites, to all the Indians of the valley, and then to the valley itself.

VILLAGES IN YOSEMITE

The points on the floor of Yosemite at which the Indians at one time or another lived or camped are numerous. Dr. C. Hart Merriam, the greatest living authority on these people, enumerates about forty such spots and supplies the information which he obtained about them and verified from the Indians. The principal sites are, in order down stream on the north side of the Merced and proceeding up stream again on the south side: Wiskala, at the foot of Royal Arches; Yowachki, near the mouth of Indian Canyon (this site is still occupied by a few families); Awani and Kumini, near Yosemite Falls, the former being the more important, in fact recognized as the largest and most permanent settlement in the Valley in aboriginal days; Hakaya, near the Three Brothers; Kisi and Chuchakala, opposite the last, on the south side of the river; Loya, at Sentinel Rock; Hokokwila, where the Sentinel Hotel now stands; Tuyuyuyu, near the Le

Conte Memorial Lodge; and Omato, between Camp Curry and the Happy Isles.

It should be said, however, that these villages were preëminently summer encampments. Now and then a few families with an unusually favorable stock of supplies hoarded up, might remain in the valley from autumn to spring, but the majority of the inhabitants annually retreated to the canyon of the Merced River below El Portal in order to avoid the heavy snows of the 4000-foot altitude of Yosemite. Down below they waited, no doubt impatiently, for spring to come and permit them to resume occupation of the most favored of their hunting and food-gathering grounds. It may be added that the Indians, as their legends clearly indicate, were pretty fully aware of the extraordinary scenic features of the Valley, and derived much satisfaction from them; although with their native stolidity they no doubt expressed themselves less extravagantly than is the Caucasian habit.

The number of the band at the time of discovery is not accurately known, but may be estimated to have been in the vicinity of two hundred and fifty souls.

ENCOUNTERS WITH THE AMERICANS: TENAYA

It was their raids on miners, prospectors, and scattered storekeepers, that in 1851 led to the formation of a little volunteer army known as Savage's Mariposa Battalion. This company went up into the as yet unpenetrated mountains in pursuit of the Yosemite "Grizzlies" and to their overwhelming astonishment burst into the hitherto undiscovered valley. In the fighting that followed, the Indians were defeated, and part of them, including the Chief

Tenaya, captured. The prisoners were taken to the San Joaquin Valley and put on a reservation. Here they kept the peace, but were in great distress of mind on account of their deprivation of the natural foods to which they were accustomed in their own haunts, as well as owing to their enforced contiguity to alien or hostile tribes. Tenaya pleaded to be let off. He was finally released, returned to Yosemite, and within four years was followed by all the surviving members of the band. The old chief did not long survive: he was killed by the Monos. He was not only a brave warrior but an unusual personality, who maintained his authority over his people by his native influence and by the respect which he commanded rather than by any legal position.

MARRIAGE

The Miwok social customs were numerous, and many of them strangely different from our own. The curious system of intermarrying divisions brought it about that a person always knew automatically to which moiety any given blood relative belonged. His father, his father's father, his brothers and sisters, his children (if he were a man), his son's children, and his uncles and aunts on the father's side, were always of his own "side." His mother, her father, his wife, his father-in-law, his daughter-in law, and his daughter's children, inevitably belonged to the opposite division. His mother's mother, however, was always on his own side of the line-up. A woman differed from a man in that her children always belonged to the opposite division. Cousins were divided between the two sides according to whether the connection

between them was through the male or the female line.

The dual totemic division was reflected in the personal names also. Any man, woman, or child, if his or her name referred to coyote or deer or beaver or otter or crane or salmon or salamander, or even indirectly alluded to these animals, was thereby designated as forming part of the water division. On the other hand, if his name had any reference to bear or wildcat or squirrel or raccoon or raven or a host of other animals he was a "landsman."

A curious custom was that while in general marriage with any blood relative, even of the seventh degree, was absolutely prohibited, an exception was made in favor of certain first cousins. Such cousins were in fact more or less expected to marry, if there was no satisfactory reason to the contrary. Which cousins were available for marriage, depended on the dual division principle. A man could never marry his father's brother's daughter, because the two brothers, and therefore their children, would belong to the same division. Cousins sprung from two sisters were also ineligible, because, even though women did not transmit descent to their children, sisters were forced to mate with husbands of the opposite moiety; consequently their offspring would also be of the same descent and ineligible to one another. The daughter of one's mother's brother, however, was looked upon as one's natural spouse. A simple calculation will show that such a cousin must always be of the opposite division from oneself.

How this curious plan of relationships, marriages, and descent originated is unknown. The Miwoks themselves can give no explanation but take for



Miwok woman pounding acorns in bedrock mortar hole

Photo by Univ. of Calif., Department of Anthropology



PLATE V

Kalapine, an old Yosemite medicine woman, making a coiled basket. The process of manufacture, which is one of sewing, can be seen. Her hair is cut short in mourning

Photo by J. T. Boysen

granted that the system has existed since the beginning of the world, and look upon us as very strange beings for not observing the same customs. It is probable that the psychological root of the observances was a desire to keep the blood mixed; although if such were the case, the original purpose was certainly defeated by the system of first-cousin marriages.

The newly wedded man was expected to show deference to his wife's parents by avoiding them as much as possible, especially the mother-in-law; and his wife behaved similarly toward his mother and father. The young people did not look their elders in the face or speak to them. If communication was necessary, the husband would address himself to his wife, and she in turn would repeat the statement to her mother, who would make the necessary answer by the same route, even though all three might be sitting in the same lodge. For a young man to do otherwise, would be the grossest breach of decorum, and the old lady would no doubt complain to her friends that her daughter seemed to have married a man lacking in all propriety and affection. This is another custom which the Indians assume is self-evident, and when asked for a reason they can give none except that they would be mortally ashamed to behave otherwise.

BABIES

When a child is born, both father and mother have certain taboes imposed upon them. The man may not hunt nor do other than the necessary work, and both parents sit as quietly as possible about the house. After this follows a longer period during which they

are free to resume normal occupations but must not eat certain kinds of food under penalty of injury to the health of the child.

The Miwok baby is put into a frame or "carrier," a sort of flat, hooded basket woven of slender sticks. In this it spends the greater part of the first twelve months of its life, and is easily carried about by the mother. The baby carrier has the further advantage of seeming to keep the infant still and contented. It is a notorious fact that Indian babies cry much less than white ones, and the native mothers declare that if they remove the children from their carriers the kicking about of legs and arms soon induces restlessness, discontent, and bawling. The woven hood of each of these tiny cradles is ornamented with a little pattern which differs according to sex. Zigzags or diagonal stripes show that the inmate is a boy, whereas a girl is indicated by a pattern of diamonds.

DEATH AND MOURNING

When a Miwok died, mourning and wailing were intense. His name must under no circumstances be spoken. To do so might invoke the ghost, and would in any event be considered as the deepest of all possible insults by his relatives. A widow cropped or burned her hair very short, smeared melted pitch over it, and also covered her face and breast with the same material. During the whole period of mourning she was not allowed to wash these parts of her body. After a few months of pitch and dirt, her appearance was a startling one: sufficiently forbidding, no doubt, to deter any prospective suitor. For the whole of the first year of her widowhood, also, she kept silence, or

spoke only in low whispers to a female relative when the occasion was imperative.

Once a year, in each region of the Miwok country, usually in late summer or autumn, a great commemorative mourning ceremony for the dead was held, which lasted amid wailing and singing for several nights. Toward daybreak on the last morning immense accumulations of food and property were thrown into the fire by the mourners. Those of the deceased who had been of special rank, or particularly beloved by their survivors, were represented by rude effigies which were also consumed in the blaze. After this the mourners of the land side were ceremonially washed by the water people, and vice versa, to signify their cleansing from the period of grief and from the restrictions which they had been under. For the widow it was also a much needed literal cleansing.

MEDICINE-MEN

When an Indian became sick, a shaman or medicine man was called in. This individual had acquired his power from spirits. He was believed to possess the power of clairvoyance. After dancing, singing, manipulating the patient, and other preliminaries, he would declare that the illness was due to the infraction of some religious taboo, or that some evil-minded medicine-man, a witch or wizard, had managed to lodge some foreign object or noxious little animal in the body of the sufferer.

He then proceeded to remove the poison by sucking the part affected, and finally pretended to remove a little mass of straw, a wisp of hair, a dead grasshopper or lizard, or something of that sort. The patient and

his relatives of course felt immeasurably relieved, and, confidence having been regained, nature in most cases concluded the recovery.

If, however, the medicine-man was unfortunate and lost several patients, especially if these died in rapid succession, he paid dearly for his preëminence. The Indians were so convinced of the complete power of these shamans, that they gave them entire credit for every cure that happened. Consequently they were quite logical when they reasoned that the death of a patient must be due to the unwillingness or evil disposition of the practitioner. One or two fatalities might be pardoned as due to mere incompetence; but suspicion would be gathering, and after his third or fourth loss, the medicine-man's life was worth little. The relatives of his deceased patients were simply waiting for an opportunity to ambush and murder him, and he must be a wary or powerful man indeed to escape permanently. Even to-day an occasional murder among the Sierra Nevada tribes can be traced to a lingering of this old custom.

MYTHS AND ORIGIN BELIEFS

The myths and legends of the Yosemite band rested on the same ideas as those current among the other Miwok. From these latter we gather that it was currently believed by the natives that this earth was peopled six successive times. The first world was dominated by a cannibal giant Uwulin who gradually devoured its inhabitants until little Fly discovered a tiny vulnerable spot in his heel—like that of Achilles—and despatched the malefactor. The people of the second world were not much better off, for they were

stolen away by an immense bird, a sort of Roc, named Yeelikin, and the remainder were persecuted by ants until they were driven away. The third world was peopled by beings who were half human and half animal, and came to an end with their transformation into complete animals—a sort of retrograde evolution. The fourth race was vexed by its chief, Skunk, who kept for himself all meat, until his people succeeded in destroying him by strategy. In his death agonies Skunk upheaved the mountains. This race was also transformed into animals. As to the fifth world, tradition is obscure, but the sixth peopling was accomplished by Coyote. The earth was at this time covered with water, but Coyote had Frog dive and bring up a bit of soil from which he created land. He then caused vegetation to grow up and made human beings. He and his associates, who up to this time had been more or less human or even superhuman in attributes, then became changed into animals like those which we see to-day.

In the story of the origin of death among mankind, Coyote also figures. His plan was to have people covered up for four days and then arise reborn in the prime of manhood. For a while this arrangement worked to the satisfaction of everyone. Once, however, a person died just as Meadow-lark took to himself a wife. After a day or two, odors of decay began to arise from the blanket-covered pile and penetrated to the hut of the honeymoon couple. Meadow-lark resented having his bliss disturbed in this way, and proclaimed that a much better plan would be to burn up the source of the stench and leave everyone in peace. His counsel prevailed and the first cremation took place, which the Miwok have adhered to ever

since; but with it there passed away the habit of human lives being renewed over and over. Although they believe this tale, the Miwok seem to bear no resentment against Meadow-lark.

The greatest hero of Miwok legends is Wekwek, the Falcon, son of Condor or according to other versions of Yayil, and grandson of Coyote. Falcon fought and overcame a destructive giant, Kilak; escaped a fire that consumed the surface of the world; and underwent numberless other adventures. More than once he was killed and restored to life, and at other times he brought back among the living his father, his sister, or some friend. The Miwok never tire of telling about this character, who impersonates all that they conceive of daring and magic and skill in the days of long ago.

LEGENDS OF YOSEMITE

About Yosemite Valley proper there are a number of Indian stories which have repeatedly been recorded with but little variation, so that they may be considered authentic. The favorite one tells of a woman named Tiseyak who lived far down the Merced River, in or near the plains. Having quarreled with her husband, she ran away eastward, creating the course of the present stream and causing oak trees and other food-bearing plants to spring up along her route. In Yosemite Valley her husband overtook her and beat her soundly. In the scuffle, the hooded baby-cradle which she was carrying was thrown across to the north wall of the canyon, where the bent hood can still be seen in the Royal Arches. A globular basket which she had brought with her, landed bottom upward and became Basket or North Dome. The husband, who

is known in the story as Nangas, "her husband," turned into North Dome or Washington Tower, whereas Tiseyak herself became Half Dome, the dark streaks on the sheer cliff of this great peak being the tears which her pain and humiliation had caused to stream down her face. The several versions vary in details, but in substance the tale is told by all the Yosemite Miwok as here outlined. It must be remembered that oral tradition can never be absolutely consistent in the mouths of separate individuals.

El Capitan, it is said, was originally a small rock. Once, long ago, a she-bear went to sleep on top with her two cubs. When they awoke in the morning, the rock had grown into the present tremendous cliff. Neither they nor the people of the village below knew how to rescue the unfortunates; until at last the Inch or Measuring Worm succeeded in humping his way up the cliff. By this time, however, the poor bear and her cubs had starved to death, and he could do no more than bring down their bones for cremation by their mourning relatives.

Measuring Worm was now possessed by the spirit of adventure. He reclinbed El Capitan, stretched himself clear across to the opposite side of the Valley, and drew himself over. Then he recrossed. This sport, however, must have weakened the walls of the canyon, for it was not long before they began to cave and the inhabitants were obliged to flee down the river in order to save themselves. The Indians say that before this catastrophe the Valley was even deeper than it is at present.

Waterfalls are dreaded by the Miwok, and both Yosemite and Bridalveil Falls are believed to be in-

habited by spirits, those in the former being known as Poloti, and in the latter as Pohono. They cause gusts of wind which are likely to whirl into the falls people who venture too close. Once the Poloti captured a girl. She had gone to Yosemite Creek from Awani or a neighboring camp to bring back a basket of water. When she dipped up, it was full of snakes. These the spirits had caused to enter the vessel so that she might abandon her accustomed spot and move farther upstream. Each time she dipped her basket, the unfortunate girl found more vermin in it, and so gradually she went higher and higher up until she reached the pool at the foot of the falls, when a sudden violent gust blew her in.

It was with such tales as this that the Yosemite Indians used to beguile the long winter evenings while sitting about the fire.

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IDEALS AND POLICY

OF

THE NATIONAL PARK SERVICE

By

STEPHEN T. MATHER
Director of National Parks

THE IDEALS AND POLICY OF THE NATIONAL PARK SERVICE PARTICULARLY IN RELATION TO YOSEMITE NATIONAL PARK

BY STEPHEN T. MATHER

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THE first national parks were set aside by Congress with the view of conserving some of our most strikingly scenic natural assets. Thus, previous to 1902, the Hot Springs, Yellowstone, Sequoia, General Grant, Yosemite, Mount Rainier, and Crater Lake national parks were reserved from public entry. These national parks of early date were merely set aside for the future; indeed, no national park policy or central organization which would make them available as vacation centers for the American public was at that time deemed necessary. In the following years to the time of writing Congress set aside twelve other areas as national parks making a total of nineteen parks, seventeen of them within the boundaries of the United States, one in Alaska, and one in the Hawaiian Islands.

Previous to 1915 the parks were all administered with the aid of the War Department, and policies and the interpretation of rules and regulations varied greatly on the different reservations. Up to 1918 road work in Yellowstone and Crater Lake parks was handled by the engineers of the War Department, but since that time all administrative activities in the

parks have been handled by the Interior Department. In 1916, Congress passed a bill creating the National Park Service as a bureau of this department. Since its establishment much has been said about the Service both in compliment and criticism and it is with pleasure that the writer hails this opportunity to explain how the ideals and policy of the Service govern the administration of Yosemite National Park.

In his message to the Director of National Parks, former Secretary of the Interior Franklin K. Lane concisely and accurately summarized the policy of the Park Service into three broad principles: "First, that the national parks must be maintained in absolutely unimpaired form for the use of future generations as well as those of our own time; second, that they are set apart for the use, observation, health, and pleasure of the people; and third, that the national interest must dictate all decisions affecting public or private enterprise in the parks." So much for our ideals. Let us now consider each of the three fundamental principles as they are applied by the Service in Yosemite National Park.

The first principle, "*that the national parks must be maintained in absolutely unimpaired form for the use of future generations as well as our own,*" is one that must be upheld by the Service. This standpoint has been attacked time and again by private individuals and corporations who wish to get a foothold in the people's parks for their own gain—to pasture herds of sheep in our mountain flower gardens, or to turn aside our streams and destroy some of our most beautiful falls for the sake of electric power which might easily be developed elsewhere. There are even now, at the time of writing, applications which, if approved, would

ruin the wonderful Waterwheel Falls in the Grand Canyon of the Tuolumne and turn Nevada Falls into a mild sedate affair instead of the wonderful torrent that now pours over its granite rim in the spring months. Let the lower levels of streams like the Merced be developed before destroying the beauty of the high country. The Yosemite Power Plant built by the National Park Service well below the Valley is a practical example. If in years to come hydro-electric development demands the destruction of beauty spots of the High Sierra after other sources of power have been exhausted, it will be well to consider then, but that time is not yet.

The public is one of the best allies of the Service in many of its practical problems of "preserving the park absolutely unimpaired." Campers realize the justice of being allowed to use only dead wood for their fires. It is especially gratifying to note that fewer forest fires are caused each year by the carelessness of campers; indeed, many fires are discovered, reported, and fought by them. People are coming to realize that thousands of unafraid live deer and elk are much more to be preferred than a few invisible or dead ones, and hundreds of real sportsmen get more pleasure hunting with camera in national parks than they would with gun outside.

In this task of preserving the park one of the arch-enemies of the Service is *fire*. Rangers are always on the lookout for the first sign of smoke and others are always ready to go on duty as fire fighters, staying with the fight night and day until the Forest Fiend is conquered.

Often one sees in the Sierras dead or dying trees which have been attacked by insects. A specially

qualified ranger is assigned to the work of fighting these pests in coöperation with the Bureau of Entomology of the U. S. Department of Agriculture—another phase of the preservation of our parks.

Some of the roads in the western part of the park, notably the Wawona Road, traverse private timber holdings. By negotiating with the owners of these timberlands the government has exchanged stumpage in various out-of-the-way sections of the park and thus preserved the scenic beauty of the roads.

It is with the second ideal, "*that they (the parks) are set apart for the use, observation, health, and pleasure of the people,*" that so many of the activities of the Service are concerned. The first idea of national parks seems to have been that they were stupendous natural spectacles, to be seen (or we might say *done*) in a short time, as one might view an art exhibit or a pageant. Then came the great out-of-doors movement and, especially since the advent of the automobile, people turned to the national parks as places to *live* during their vacations and to "get next to Nature." Lastly comes the realization that our parks are not only show places and vacation lands but also vast school-rooms of Americanism where people are studying, enjoying, and learning to love more deeply this land in which they live.

In the administration of the parks the greatest good to the greatest number is always the most important factor determining the policy of the Service. During the assignment of army officers to administer Yosemite National Park all motor vehicles were prohibited from entering, but finally, in 1914, under instructions from Secretary Franklin K. Lane, automobiles were admitted under very strict regulations. Since 1915

motor restrictions have been gradually removed until there are now but a few rules and these for the safety of motorist and pedestrian alike. The advent of the automobile with the opportunity for its use freely in all the parks within the last five years has been the open sesame for many thousands; indeed, during the season of 1919 74% of the visitors of Yosemite National Park entered in their own machines.

The road problem then is one of the most important issues before the Service. Outside of possibly Yellowstone there has been but little development in the parks to enable the motorists to have the greater use of these playgrounds which they demand and deserve. Definite projects have been laid out by the Service in all the larger parks calling for important road building, but up to the present time no substantial funds have been available to carry them out. Congress, the appropriating body, has been engrossed with its war problems, but I now feel that the turning point has arrived. As an indication of the interest of that body it might be mentioned that during the present season (1920) the House Appropriations Committee visited seven of the largest parks and expressed themselves as deeply impressed with the needs of the Service.

As regards Yosemite National Park much remains to be done in the way of road development. A substantial piece of work has been accomplished in the reconstruction of the road from Yosemite Valley to the El Portal Entrance, a total of seven and a half miles built at the cost of a quarter of a million dollars. This is the only heavy piece of road work which has been done in any of the parks during or since the war period. This will connect with the all-year-round highway which the State is building up the Merced

Canyon and which will make the Valley more readily accessible to motorists in winter than it now is in summer. The certain great increase of travel into Yosemite Valley by this easy grade road makes it necessary to provide a convenient outlet into the back country. This outlet will be the road which has been surveyed from the Valley by Vernal and Nevada Falls into the Little Yosemite Valley, thence connecting with the Tioga Road at Lake Tenaya. The survey has been carefully run so as not to interfere with the beauty of the falls.

The other approach roads to the Valley—the Big Oak Flat and the Wawona—must be widened and their grades lowered, and the Tioga Road should have many of its bad pitches smoothed out. Perhaps a spur road should be built up the Lyell Fork, connecting with the Tioga Road at Tuolumne Meadows, thus opening up additional camping country in the scenic Mount Lyell region.

The beautiful Tuolumne Meadows, considered by John Muir and the Sierra Club the finest camping ground in the High Sierra, will come into much greater use when the new lodge for visitors is established there (1921). A store has been started which is proving very useful to the campers in this section.

While the motorist will find a great area of the park accessible to him under the plans indicated, there will be a large proportion of the park preserved for trail trips only. The rugged canyons north of the Tuolumne River will be for many years to come devoted to trail travel, and Superintendent Lewis has plans for developing the present trail system there which will make this magnificent section of the park more accessible.

Each year sees the park better developed for the use of the people. The Free Public Camps in Yosemite Valley have become very popular, a total of twenty-three thousand four hundred persons having been registered during the season of 1920. Better facilities must be provided in these camps; the sanitary system by which they will largely benefit is already under construction, and all the camps should be lighted by electricity. Time and again European visitors express astonishment that all this service can be free. To them it is as incomprehensible as is our sense of American freedom.

As rapidly as conditions permit, the system of lodges should be extended farther back into the High Sierra so that hikers may walk from place to place on the highland trails and be sure of food and shelter at the end of each day's travel.

Yosemite National Park is already a fisherman's paradise, especially in the High Sierra country. Each year many of the lakes and streams are stocked with trout fry, but even more should be done, and each body of water in the park should be made productive. A hatchery which would supply the needs of the park must be built in Yosemite Valley where it will be an object of interest and instruction to thousands of visitors.

To further exemplify the principle of *use* the Service allows the grazing of cattle on lands which are not used by tourists. Overstocking, a condition which in some sections of the High Sierra has made it next to impossible for a camper to obtain feed for his stock, is carefully guarded against.

Upon the principle that the parks are set apart for "observation by the people" are based many of the

most recent activities of the Service. The establishment of the Free Nature Guide Service during the season of 1920 proved a great success. The quickening interest in Nature-study work under Dr. H. C. Bryant and Dr. Loye Miller points the way for us to develop this work on a far greater scale in the Yosemite as well as other national parks in future years.

The Yosemite Museum is the outcome of the public demand for authentic exhibits of natural history, geology, ethnology, botany, and other sciences so well exemplified by the region. The museum was made possible almost entirely by gifts and loans of private individuals and will be developed as rapidly as possible by the Park Service.

The Le Conte Memorial Lectures which are given in Yosemite under the auspices of the Extension Division of the University of California have been very useful in bringing to the tourist a better knowledge of the park and of men like Le Conte and Muir who have told its story so well.

In recent years there has been a movement to take classes into national parks for instruction and it is now a common experience to meet university students, troops of Boy Scouts, and other groups studying Nature first-hand. Such use of the parks is strongly encouraged by the Service.

The function of the parks as factors in increasing our national health, vitality, and happiness is a most important one. To encourage clean living in God's great out-of-doors should be one of the primary ideals of the Service. The European visitor whose ideal vacation so often consists in lounging about a hotel and viewing Nature from the veranda, marvels at the number of people he finds hiking, riding, swimming,

or otherwise engaged in strenuous sports in the Yosemite. Let us encourage this American spirit to be up and doing. Of course there are those who require "artificial" amusements and there will always be entertainments, dancing, bowling, pool, etc., at the larger hotels, camps, and lodges. Let us not, however, "vulgarize" the parks as has been the accusation of some visitors.

I hope that winter sports in the park will become a great feature. If Glacier Point with its beautiful hotel were available in winter time, Sentinel Dome with its heavy snowfall could be made to rival St. Moritz. To reach this altitude in winter the suggestion has been made for the construction of a shaft by which the tourist would be carried directly from the Valley to Glacier Point. If this plan is carried out it must be done without marring the beauty of the canyon walls. Anything in the nature of an outside structure could not be considered.

The third ideal of the Service, "*that the national interest must dictate all decisions affecting public or private enterprise in the parks,*" is one phase of the parks policy which is least understood by the public. When the Department of the Interior assumed complete administration of the parks each public utility was handled by a separate individual or company. Under these conditions results were not always satisfactory and prices were sometimes abnormally high. Finally a large corporation, the Yosemite National Park Company, made up of hundreds of stockholders, principally public-spirited citizens of Los Angeles and San Francisco, was organized and all concessions excepting the photographic studios, a bakery, the Yosemite Hospital, and Camp Curry were turned over

to it. This organization has been doubly necessary during the past few seasons because of the greatly increased travel and the corresponding increase in investments necessary to allow for unlimited and immediate expansion. The government regulates prices and this very easily by dealing with one central office. Furthermore of all of the profits made by this large company, over and above six per cent. for physical investment, the United States Government receives $22\frac{1}{2}$ per cent. While much criticism was at first expressed on the part of local concessionaires over the concentration of all public utilities, it is now generally realized that this is the only system of management which could have kept pace with the park development, and being a problem of national interest it was decided by the Service with a view to the greatest good to the greatest number.

In conclusion let me say that the development of the Park Service has been more than gratifying, especially as regards the *esprit de corps* which has not only made the organization efficient but is daily exemplifying the true meaning of *service*. The ideal of each individual member of the Service and of the Service itself is to *give* to the public not merely what they pay for, but everything within power.

ADMINISTRATION



OF

YOSEMITE NATIONAL PARK

By
W. B. LEWIS
Superintendent
Yosemite National Park

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Superintendent, Yosemite National Park

YOSEMITE NATIONAL PARK, which covers 1125 square miles, an area nearly as extensive as the State of Rhode Island, is a national reservation. It is completely subject to federal administration and is governed by rules and regulations prescribed by the Secretary of the Interior under authority of the law. The enforcement of the laws and regulations is entrusted to a Superintendent who resides and maintains headquarters in Yosemite Valley and who is directly responsible to the Director of the National Park Service, the chief administrative officer of the entire National Parks system.

The duties of the Superintendent are multifarious. He must supervise the many governmental activities, some of which are the task of building and maintaining roads and trails; the building of telephone and telegraph lines and the operation of telephone and telegraph service within the park, and to the connection of these lines with the outside commercial lines; the building of power transmission lines and the operation of the government-owned and -built 2000 kilowatt hydro-electric power plant; the building, maintenance, and operation of the park shops and barns; the con-

struction and maintenance of living quarters for the employees of the government; the operation of construction camps for the working men; the installation, maintenance, and operation of water and sewage systems; the care of public grounds; the policing and maintenance of the public camping grounds, etc.; and the administration of the park ranger force. The duties of this last branch of the service include the general policing of the park for the protection of fish and game, the prevention and extinguishing of forest fires, the regulation of traffic, and the general preservation of order, the checking of automobiles, and the maintenance of an Information Bureau for the dissemination of accurate, reliable, and impartial information on all matters of interest to park visitors.

The Superintendent must also hear complaints, arbitrate differences between individuals or parties, supervise the activities of those individuals or corporations who operate hotels, camps, transportation services, etc., under government franchise, and adjust differences between such individuals and corporations themselves or between them and the public.

The Superintendent further has supervision over the cutting of timber on private lands within the park and on government lands where, through exchanges with private owners to preserve privately owned timber of scenic importance, such cutting is permitted. He must also see that the government's interests are not impaired under the operation of power and water supply projects where they are authorized by law as, for instance, in the case with the City and County of San Francisco in the development of its power and water supply project in Hetch Hetchy Valley.

With this diversity of governmental activities the administrative organization is divided into various departments, each with its supervising officer and each with clearly specified activities and duties. These various administrative and operative units together with their general duties are enumerated below.

Department of General Administration. The Assistant Superintendent is in charge of this department and the activities are as follows: general office management; purchase of supplies and equipment; disbursing of pay rolls and accounts; timekeeping; accounting; collections of revenues from sales, franchise fees, and fees from all other sources; appointments; employees' compensation; preparation of contracts and vouchers; sales; and the numerous details of local routine matters.

Department of Maintenance and Operation. The activities of this department, which is administered by a Park Supervisor who is assisted by an Assistant Supervisor, are the most varied of any of the park administrative units. They consist principally of the maintenance of the 138 miles of park roads and 600 miles of trails, of some 200 government buildings, and of approximately 5 miles of water lines; the maintenance and repair of all buildings, fences, and bridges; the care and distribution of stock and transportation facilities; upkeep and repair of tools and equipment; care of public grounds and camps; disposal of garbage and waste; and the production of wood, ice, hay, etc.

Department of Engineering. A Resident Engineer has direct charge of this unit and his duties consist mainly of the advisory supervision of all outside maintenance work; the making of surveys for roads, trails, pipe lines, etc.; the preparation of plans, designs, and

specifications for construction; and the inspection of contract work.

Ranger Service. It is with this phase of the park administration that the public comes most in contact. The Ranger Service consists of a force of from ten to thirty rangers (depending upon the season of the year) under a Chief Ranger.

The park is divided into a number of districts and, during the summer months, in each is stationed a mounted ranger who is responsible for the proper patrol of his district. It is his duty to inform, assist, and instruct the park visitor, to prevent and extinguish forest fires, to protect fish and game in accordance with the park rules and regulations, to inspect camping grounds, and to enforce the rules and regulations, making arrests when necessary.

Traffic rangers, mounted on horses and motorcycles, are stationed on the floor of Yosemite Valley. While their principal duty is to regulate traffic, they must also be informative to the public, patrol for fire, police camping grounds, and, in general, preserve law and order around the village, camps, and hotels.

A specially qualified ranger is also in charge of the Information Bureau which is maintained at the Park Headquarters. Here information concerning roads and trails and all other matters of public interest concerning the park is given out; campers are registered; park publications and maps are distributed and sold; and bulletins concerning roads, trails, and general park conditions are prepared from time to time for distribution to newspapers, automobile clubs, and other organizations interested.

Checking or automobile rangers are stationed at all of the road entrances to the park, and at the top



NATIONAL PARK SERVICE INSIGNIA

- 1.—Director of National Parks (Gold Star)
Assistant Director of National Parks (Silver Star)
- 2.—Park Superintendent
- 3.—Assistant Park Superintendent
- 4.—Park Engineer
- 5.—Assistant Park Engineer
- 6.—Chief Park Ranger
- 7.—Assistant Chief Park Ranger
- 8.—Park Ranger
- 9.—Temporary Park Ranger
- 10.—Ranger's Badge
- 11.—Collar Insignia

and bottom of the steep grades entering Yosemite Valley. They issue permits, collect automobile fees, distribute park information, and collect and seal firearms. Records are kept of every automobile or other vehicle passing the stations, together with the number of persons carried and the exact time of leaving the stations. Checking rangers are also called upon to do their share towards the effective operation of the park by observing for fires, reporting violations of regulations, etc.

Electrical Department. Under this department falls the maintenance and operation of the park telephone, telegraph, power, and lighting systems. A Chief Electrician is in direct charge.

The telephone and telegraph system of the park consists of approximately 210 miles of telephone lines, to which are attached from 100 to 175 telephones. These lines radiate from Yosemite Valley to various parts of the park, and fifteen miles of telegraph line links Yosemite with El Portal where connection is made with the lines of the Pacific Telephone and Telegraph Company.

A 150-line switchboard is operated continuously on a 24-hour basis throughout the year, and local and long distance service may be had from all hotels, camps, or ranger stations throughout the park.

The main telegraph office is located at the Park Headquarters Building in Yosemite Village, but messages may be filed and received at all hotels and camps. A messenger service is also provided during the summer months but this is of necessity limited to Yosemite Valley.

The electrical system consists of a hydro-electric power plant of 2000 kilowatt capacity, located on the

Merced River a short distance below the western end of Yosemite Valley. This plant was completed in June, 1919, at a cost of \$212,000.00 and serves seven miles of high power transmission line and approximately nine miles of distributing lines. The energy here developed is used for power, lighting, heating, and cooking purposes in the hotels and camps, and in the residences of park employees and other government buildings.

Department of Forests and Timber. Under the supervision of a Park Forester this unit of park administration is charged with the supervision of timber operations in the park and the immediate representation of the federal government on the Hetch Hetchy project in course of development by the City and County of San Francisco.

Special work having to do with the forests of the park is also assigned to this department.

Mechanical Department. This department is presided over by a Master Mechanic who has charge of the operation of the machine shop and the maintenance and upkeep of all motor-driven vehicles. To him is also assigned the task of advisory supervision of the upkeep and operation of all power-driven machinery and plants.

In addition to the more or less specific activities enumerated above, numerous problems of a special nature are from time to time taken up in connection with other bureaus or departments of the State and National governments. Control of the mosquito nuisance is carried on in coöperation with and under the advice of the United States Public Health Service of the Treasury Department; the study of forest insects and application of the findings of the Bureau of

Entomology of the Department of Agriculture in the elimination of insect depredations on the park forests are effected by the park force in coöperation with that bureau; the planting of fish in the park waters is done in coöperation with the California State Fish and Game Commission; methods for the extermination of rodents in Yosemite Valley are applied under the advice of the Biological Department of the Department of Agriculture; and in coöperation with the Forest Service the problem of the preservation of timber along the roads leading to the park is being worked out.

Hence the administration of the park, in its position as a separate and independent nationally governed unit which compares with the District of Columbia so far as form and application of government is concerned, places, on the small scale, upon its administrative organization many of the same complex problems of administration and operation that confront the local government of that reservation—problems and difficulties that are, however, little realized by the casual visitor to the park whose soul and mind are occupied in absorbing scenery and with getting the fullest enjoyment out of his holiday.



GEOLOGY

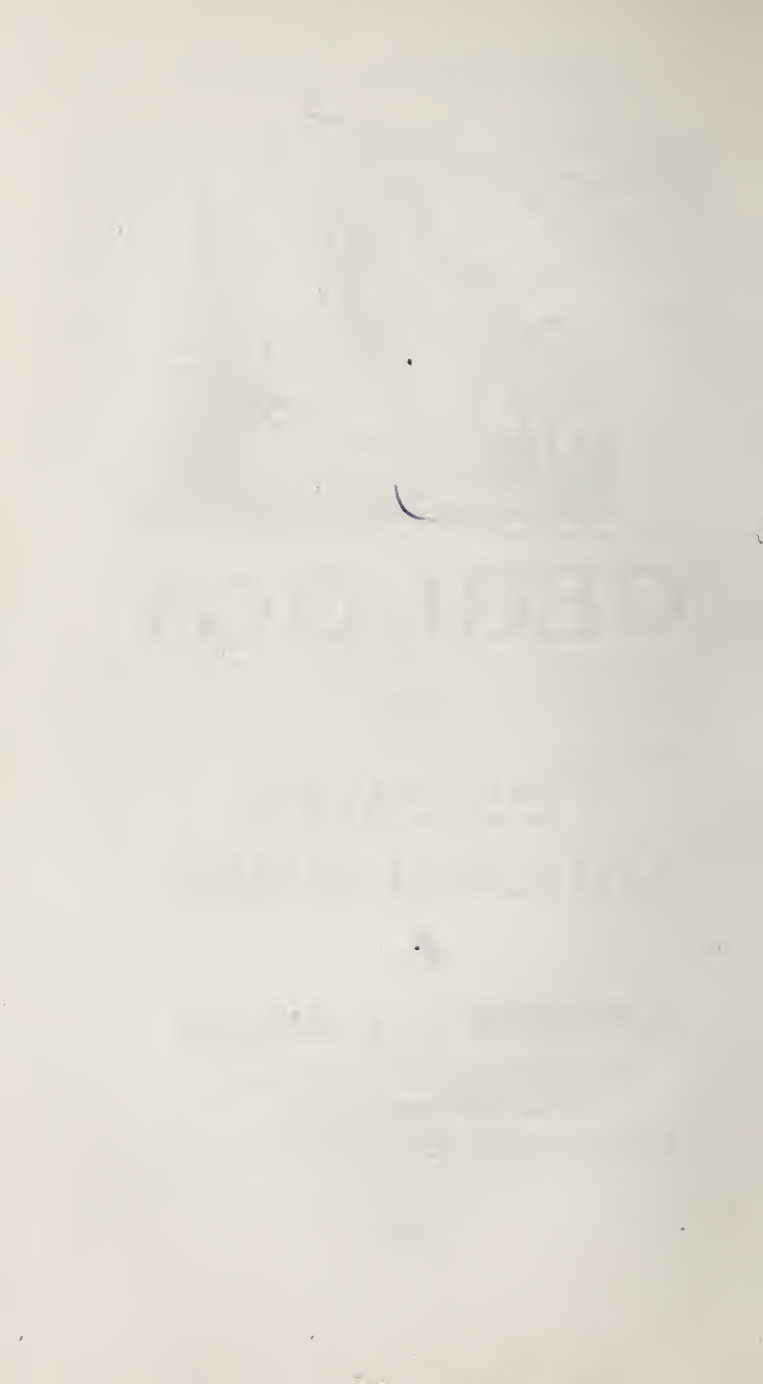
OF

YOSEMITE NATIONAL PARK

By

ANDREW C. LAWSON

Professor of Geology
and Mineralogy
University of California



GEOLOGY OF YOSEMITE NATIONAL PARK

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FROM a geological and physiographic point of view the Sierra Nevada is, as its Spanish name implies, a single range built on very simple structural lines. It belongs to the class of mountains of the Basin Range type, so called because it is best exemplified in the Great Basin, that great region of no drainage to the sea which lies between the Sierra Nevada and the Wasatch. In this region the earth's crust has been broken into blocks, elongated in a general north-south direction. Some of these have been depressed and lie beneath the broad valleys of the desert, while others have been uplifted and constitute its linear mountain ranges. The uplift has, however, not been uniform in most cases, but has been effected by a rotation of the block on an axis parallel to the range. It results from this that the block as a whole has been tilted so as to present a steep front, or scarp, on one side and a gentle slope on the other. The simplicity of the profile thus produced has of course been greatly modified by the erosion of the block which has taken place in the long period of time that has elapsed since its uplift.

The Sierra Nevada is one of these uplifted and tilted blocks, presenting a very steep, bold front to the east and a slope of only about 2° to the west. The edge of the tilted block is the crest of the range; its eastern front is the surface of the break whereby it was dislocated from the relatively depressed region of the desert; and its western slope represents the old, low surface of the region before it was elevated. ~~P~~ Both the eastern front and the western slope have suffered greatly from erosion since the range came into being by this process of uplift and tilting. On the east the fault scarp has been battered to a slope much less steep than it was originally, and the crest of the range has thereby migrated westward. On the west the tilting of the surface determined a drainage by streams running transverse to the axis of the range; and these, by reason of their velocity, cut sharp trenches, which in the course of time have been deepened and widened into the great cañons of the Sierra Nevada. On the divides between the cañons, in cases where their slopes have not yet intersected, there are still remnants of the old surface much in the same condition as it was before the uplift. From these flat-topped divides, an observer may get such extended views in all directions that he forgets he is in the mountains, and, overlooking the deep cañons, gets the sensation of being on a vast sloping plain with occasional low hills rising above the general surface. It is this plain which has a slope of 2° from the edge of the Great Valley to the region of the summit peaks and crests. Its remarkable evenness on many of the divides, particularly in the northern part of the range, is due to the fact that the region before its uplift was extensively covered by deposits of meandering streams, and these in turn

covered by layers of volcanic ash, agglomerate, and lava, thus smoothing out and obscuring the inequalities of an erosional surface of comparatively low relief. Considered in the light of these observations and viewed in its entirety, the Sierra Nevada is recognized not only as one of the Basin Ranges, but as the most perfect and most magnificent example of the type.

The uplift of the Sierra Nevada was not, however, a simple sudden event, nor even a continuous process of earth deformation. The uplift proceeded by stages of which two are strongly pronounced, particularly in the southern part of the range. Between these stages the process of tilting stopped for a long time, and in the interval the cañons, which had been deepened to the limit for the first stage, were widened into broad flat-floored valleys. As a consequence of the second stage of uplift, the streams flowing through these wide valleys were rejuvenated and resumed the work of cañon cutting, leaving large remnants of the old valley floors as benches or terraces above the brink of the cañon walls. The high valleys that border the cañon of the Kern are perhaps the best records of this period of stability in the Sierra Nevada between two stages of uplift. The wide, level, rock floor of Tuolumne Meadows, by its contrast with the gorges of Tenaya Creek and Tuolumne River below the Meadows, suggests that it, also, may have been developed in its preglacial outlines, during this same period of stability.

The uplifting process of the second stage is not yet completed. In 1872, at the time of the heavy earthquake of that year, a movement occurred on the great fault which bounds the Sierra Nevada on the east.

By this movement the elevation of the southern part of the range, in relation to Owens Valley, was increased by about twenty feet; and a fresh scarp was formed, causing a sharp step in the profile of the lower flank of the range.

Having now acquired an understanding of the general configuration of the Sierra Nevada as a single mountain of the Basin Range type, formed by the tilting of an elongated block of the earth's crust, we may proceed to consider the cañons which have been cut into the rising mass, and particularly the cañon of the Merced with its famous Yosemite Valley. With one notable exception the great cañons of the Sierra Nevada are transverse to the range. The dominant drainage still follows the lines imposed upon it consequent upon the tilting of the crustal block. In this respect the drainage pattern differs in a marked degree from that of many other mountain ranges. The main valleys and stream courses of the Appalachian Range, for example, are parallel to the length of the elevated mass, with only short transverse outlets for the extended longitudinal system. Similarly the main drainage of the Coast Range is parallel to their elongation. The reason for this is that in these and similar mountain ranges the belts of rock conform in direction to the elongation of the range, and belts of soft rock generally alternate with belts of hard rock; so that, although the drainage may have been originally transverse, consequent upon the uplift, the tributaries of these consequent streams that happened to be on belts of soft rock eroded cañons very much faster than those which drained belts of hard rock, and faster than the consequent streams, which traversed both hard and soft belts. The result

of this has been that, in the course of time, the great valleys of old mountains become located in the soft belts, and so become the dominant features of the drainage systems. Such longitudinal drainage is technically designated *subsequent* to distinguish it from the earlier transverse or *consequent* drainage.

The reason that no notable subsequent drainage has been developed in the Sierra Nevada is twofold: 1. The time that has elapsed since the uplift of the range has been so short that, even in the northern part of the range where the contrast of hard and soft belts is pronounced, the tributary streams have as yet made but little headway in establishing their domination. Geologists and geographers regard a well developed subsequent drainage as characteristic of a relatively old mountain range. So we may classify the Sierra Nevada, on the basis of the meagerness of subsequent streams, as a young mountain range. 2. In the southern part of the Sierra Nevada there are but few contrasts in the hardness of the rocks, the mass of the mountain being almost wholly granite, so that the condition favorable for the development of subsequent streams, on a well-marked longitudinal pattern, is lacking.

The notable exception to this transverse disposition of the Sierran streams is the Kern River. This stream, however, had its position determined for it by a remarkable rift in the earth's crust, parallel to the great fault which marks the eastern boundary of the range.

Long after the uplift of the Sierra Nevada to practically its present altitude, after the cañons had been eroded down to very nearly their present depth below the flat-topped divides, the climate changed for the

worse. In the summit region the ablation of summer failed to remove the snows of winter. The snows of many years accumulated and became packed down of their own weight into ice, so that glaciers were formed. At first these were small and situated on the north side of the great peaks where ablation was feeble; but later they expanded into great *névé*s from which tongues of ice extended down into the cañons. These tongues were veritable streams of ice many hundreds, and even thousands, of feet deep, which flowed slowly through the cañons for ages. They extended far below the line of perennial snows and in each case reached a limit, at the time of maximum severity of climate, at a point in the cañon where the ablation of summer just balanced the forward flow of the ice. At this point the glacier dumped the load of rock *débris* which had been shed upon it from the cañon walls above. Thus a great lunate ridge of fragments, ranging in size from grains of sand to spauls the size of a house, was formed, spanning the cañon from wall to wall. This ridge is called a terminal moraine; and there are many such moraines in the great cañons. Besides the terminal moraine, there are others farther up the cañons, called moraines of retreat, which mark stages in the waning of the glaciers when the climate again became more genial. To these moraines were delivered not only the rock fragments which had ridden on the back of the glacier to its end, but also similar fragments carried in the body of ice, which had either fallen into crevasses or had been plucked out of the floor of the cañon in places where the rock was so intersected by joint cracks as to be divided into blocks, and so easily dislodged by the ice stream. Many rock fragments were also carried



PLATE VI

Two Yosemite domes. Mount Starr King (left) and Half Dome (right) from the summit of Mount Watkins

Photo by A. D. Lockwood

along in the bottom of the ice, and these scratched, abraded, and polished the rock surfaces over which the ice flowed, and were themselves scratched, abraded, and polished by the same action. By carefully examining the material of some moraines one may find an abundance of boulders showing such evidence of abrasion; while in other moraines they are very scarce or absent.

Besides the terminal moraines and moraines of various stages of retreat, the upper slopes of the cañons formerly occupied by glaciers are in many cases, particularly near their headwaters, modified by great ridges of glacial *débris*, known as lateral moraines. These accumulations were formed in the same way as the terminal moraines due to a sideways movement of the ice to balance the ablation along its margin.

The effect of the long continued flow of these ice streams upon the configuration and aspect of the cañons is very notable, and may be observed in the upper reaches of all the great Sierran cañons. In their lower stretches, the cañons are all V-shaped in transverse profile, the slopes are uneven and generally encumbered with a mantle of rock *débris* and soil arising from the disintegration and decay of the rock under the weather. Where rock surfaces are exposed these present the appearance of fractures, or are bounded by joint planes, and the rock is usually somewhat decomposed for a short distance below the surface. As we pass up the cañons, within the limits of former glaciation, the whole aspect of the landscape changes. The cañons are no longer V-shaped in profile, but more nearly U-shaped. All of the rock *débris* and soil has been swept out of the cañon, and

bare rock surfaces are seen on every hand. These surfaces are, moreover, not commonly fractures or joint planes, but are clearly surfaces due to abrasion; since they show abundant evidence of scoring, striation, fluting, and polishing. Many surfaces are so highly polished that they reflect the sun's rays like a mirror. Where the polish is lacking it is generally evident that this is due to exfoliation, the scaling off of the rock in thin slabs, and that the polish once extended over the areas thus denuded. The bare rock surfaces have acquired rounded or hummocky forms which, from a distance and in the aggregate, look like the backs of sheep in a flock. They are therefore known technically as *roches moutonnées*. These hummocks are characteristically elongated in the direction of the cañon and have a symmetrical transverse profile but an asymmetrical longitudinal profile, with a steep front facing down stream. This asymmetry is due to the fact that the upstream side of the hummock received the full force of the abrasive impact of the ice current, whereas the tendency on the downstream side was to pull out or pluck fragments from the rock mass and so leave a steep front. The abrasion thus so apparent on the *roches moutonnées* affected all surfaces over which the ice passed. It was not done by the ice itself, however, but by the rock fragments imbedded in it. The passage of the ice stream through the cañons not only swept away all loose rock and soil on the slopes, but by this process of abrasion removed all the decomposed material, so that the rocks so generally exposed in the glaciated portions of the cañons are in a wholly sound and fresh condition. It is evident also that the abrasive process was competent to reduce even the fresh hard rock after

the superficially decomposed material had been removed. The long continued abrasion and the plucking together have deepened the cañons, at the same time giving them their characteristic U-shaped profile. One of the finest examples of the effect of ice upon the configuration of a cañon, once merely a stream gorge, is afforded by Tenaya Cañon, a good general view of which may be had from Mirror Lake.

The power of glaciers to deepen the cañons in which they flow is perhaps best exemplified in their upper reaches where the general grade is steeper. Here the characteristic longitudinal profile of the cañons is a series of steps, the present streams cascading from one level to another. On each step is a rock-rimmed basin, or tarn. In some cases there may be several such steps and tarns in the course of a mile, while in others the steps may be much broader and more widely spaced. No other agency is known whereby these tarn basins could have been formed except by the abrasive power of rock-laden ice. Seizing upon the inequalities of the original stream profile the ice has accentuated these into a series of giant steps, the treads of which suffered heavy local abrasion by the impact of the ice descending from above, while the risers were developed into cliffs by exceptionally active plucking. One of the lowest of the tarns in the vicinity of Yosemite is Tenaya Lake which lies in a rock-rimmed basin 140 feet deep.

Another extremely interesting feature of most glaciated cañons, to be found at their very head, where the ice stream has its origin, is the cirque. This is a vast amphitheatre of bare rock enclosed by nearly vertical cliffs, generally hundreds of feet high,

in the floor of which is a tarn. In some of the larger cirques there are several tarns at slightly different levels. These cirques appear as great bites in the mass of the mountain and are clustered around the high peaks of the summit that divide the drainage. They have been formed by that peculiarly vigorous process of ice erosion which, on a smaller scale, has given us the steep faces of the *roches moutonnées* hummocks, and the risers on the steps of the glaciated cañons. The glaciers at their heads ate their way into the mountain mass, by nibbling at the base of the cliffs and so undermining them. The blocks of rock plucked out from the cliffs were incorporated into the ice and carried away by the glacier to be delivered chiefly on its sides, to make the great lateral moraines which are now found below the cirques. As the process proceeded, and the cirques were enlarged at the expense of the peaks and ridges, the divides between opposing cirques were in many cases reduced to thin partitions with sharp knife-like crests. As still further enlargement proceeded, these divides were rapidly lowered. We have thus presented to us in this encroachment of cirques, one on the other, a process whereby lofty mountain crests and summits are first gradually narrowed and then rapidly reduced. This glacial destruction of mountain crests may eventually so lower the elevation that the conditions favoring the accumulation of ice may be done away with. Alpine glaciers may therefore be said to be self-destructive. The glaciation of the high Sierra, however, occupied but a brief time from a geological point of view and before the destruction of the high peaks and summits had proceeded far the climate changed and the glaciers almost wholly melted

away, leaving only remnants in a few of the higher cirques.

Of these lingering glaciers within the limits of the National Park the most notable, as well as the most accessible, are those on the east side of Mt. Dana, on the north side of Mt. Lyell, and on the northeast side of Mt. McClure. These glaciers are very small compared with the great ice stream that once filled the whole of Tuolumne Meadows, and sent one tongue down the cañon of the Tuolumne River far below Hetch Hetchy and another down Tenaya Cañon into Yosemite. They are, however, interesting features of the high Sierra and well worth a visit. Although they are very small, they have all the essential features and functions of their great ancestors except that they are in some cases broader than long. Here at the lower edge of the ice one may see a moraine in actual process of accumulation; and on searching among the bowlders one may find some that have been abraded and scratched. The ice is traversed by crevasses just as in the case of the great glaciers and riding on the ice may be seen the débris shed from the cliffs above. If we cross the glacier to its upper edge where it appears to adhere to the base of the cirque walls, we find that the appearance is deceptive, for the ice, instead of hugging closely the base of the cliffs, is separated from them by a space of several feet. The space extends down for a long distance between the wall of rock and the wall of ice as a great chasm. This detachment of the glacier from the cliffs is known as the *bergschrund*. At the bottom of the chasm goes on the plucking and sapping action which gives the cirque walls their verticality, as seen when the ice eventually vanishes.

Among the glaciated cañons of the Yosemite National Park those of the Merced and the Tuolumne are the most impressive and the most interesting. Just as at present these two streams gather up and carry forward to the San Joaquin Valley practically all the drainage of the park, so, in glacial time, the great bodies of ice which covered the summit region within the limits of the park, excepting the highest peaks, converged on the same two cañons, and flowed down them to the limit where ablation balanced the forward movement. Some of the ice, however, flowed through the passes on the crest of the range toward the east and gave rise to glacier tongues on that side which were much shorter than those on the west; because then, just as now, the climate was much drier and the summers hotter than on the west side of the summit. Most of these short glaciers on the eastern flank of the range have left splendidly developed lateral moraines. Some of these, particularly those of Bloody Cañon, Leevining Cañon, and Parker Creek, in the vicinity of Mono Lake are easily accessible to visitors in the park. It is interesting to note that, at the maximum extension of these east flank glaciers, the level of Mono Lake was about 675 feet higher than at present. At this high level the glaciers reached the lake. But even under these conditions the greatly increased influx of water from the melting glaciers was balanced by evaporation, for at its highest stage Mono Lake had no outlet. Thus we have the apparent anomaly of glaciation combined with aridity. The explanation of course is that the glacial streams flowed from a humid region west of the crest of the Sierra Nevada into an arid region to the east of the crest. The line between two strongly

contrasted climatic provinces was, however, very sharp.

In the drainage system of Merced River Tenaya is perhaps the most typical illustration of a thoroughly glaciated stream gorge. It is at the same time the most easily accessible to visitors in the Yosemite Valley. Everybody who goes to Yosemite gets a glimpse of Tenaya Cañon from Mirror Lake. Yosemite is also a glaciated cañon. There is a large moraine spanning the Valley just below El Capitan and the ice must have extended that far at least. Yet the contrast between Tenaya Cañon and Yosemite Valley is very great. If Tenaya be the type of a glaciated cañon, Yosemite must be abnormal. In what does the departure from the type consist? Evidently in the width of the Valley floor, its level character, and the entire absence of bare rock surfaces. The floor of Yosemite is everywhere sandy and there is reason to believe that the deposits of sand are several hundred feet thick. If we imagine this sand removed and the talus at the base of the great cliffs nonexistent, we would see the Valley as it actually was immediately on the retreat of the glacier. The picture before the mind's eye would then differ in no essential respect from the view we get of Tenaya Cañon. The Valley would then be true to type. It would be larger and deeper, but there are good reasons for this. The glacier entering Yosemite from Tenaya was not the only one that filled the Valley with ice. An equally important one flowed in from the Upper Merced and Little Yosemite; and another moved down the Illilouette. These three great glaciers converged on Yosemite and the cross section of the confluent glacier in the Valley was probably not less than the sum of the

cross sections of the three tributaries. This great increase in the volume of the ice, particularly as expressed in its depth, together with the steepness of approach of the tributaries to the Valley, would greatly increase the abrasive action of the glacier on its floor. Just below the confluence, that is in Yosemite, the cañon would be over-deepened and we would have a rock-rimmed basin formed, like that of Tenaya Lake but larger and deeper. Thus, in our mental picture of the restoration of Yosemite as it was at the immediate retreat of the glacier, we must introduce a beautiful lake, in which were mirrored the majestic walls encircling it. At the lower end of this lake, just below El Capitan, had been left a moraine which helped to accentuate the depression caused by the scour of the ice. Into this lake poured the sandy and milky waters of the three glaciers, now separated, during the long period of their retreat. These streams built out a delta into the lake which eventually filled it, giving us the present floor of the Valley, seven miles long and one mile wide. On this floor has accumulated the talus of rock spauls shed from the cliffs; and across the floor in a shallow sandy trench flows the Merced River, cascading over the moraine below El Capitan, giving us the Valley as we know it to-day.

Hetch Hetchy Valley is generally recognized as being analogous to Yosemite though on a smaller scale. The profound gorge of the Tuolumne, with its stepped profile of bare, glaciated rock emerges suddenly on a wide, flat-floored, sandy valley, just as Tenaya Cañon opens on Yosemite. Both valleys have had the same history. Glacial abrasion and plucking over-deepened the cañon, so that, when the



PLATE VII

The Lyell Canyon with Mount Lyell and its glacier several miles distant

Photo by Wm. E. Colby

ice retreated, a tarn occupied the basin. This tarn served as a trap for sediments brought down from the melting ice above, and the filling of the basin built out the level floor of Hetch Hetchy. The lake which will soon be created in Hetch Hetchy Valley by the dam at its outlet, now being built by the City of San Francisco, will be but a restoration on a larger scale of the lake which once existed there. The new lake will seem very natural in its mountain setting, a gem of great beauty and a delight to all who may have the good fortune to see it.

Little Yosemite Valley owes its flat, sandy floor and its breadth between walls to the same process. The valley is but a tread on the great stepped profile of the Merced; and on this tread there had been scoured out a rock-rimmed basin which, on the final retreat of the ice, contained a tarn about three miles long. Several meadows in Tenaya Cañon above Tenaya Lake are similarly filled tarns, as are also many meadows of the higher altitudes.

The contrast between the typical glaciated cañon of Tenaya Creek, and the aberrant Yosemite and Hetch Hetchy valleys is not, however, due wholly to the fact that they once held lake basins now filled with sand. The contours and the profiles of the walls of both Yosemite and Hetch Hetchy differ from those of Tenaya Cañon. The contours of Yosemite are in general zig-zag, expressive of salients and reëntnants which are full of surprises and suggest some mysteriously intentional process of sculpture. In the profiles the vertical element dominates and gives the Valley its atmosphere of solemnity and majesty, the same atmosphere which the great architects of the Middle Ages gave to their splendid Gothic cathedrals. These

features are in striking contrast with the smoothly flowing, though undulatory, contours and profiles of Tenaya Cañon below Clouds Rest as seen from Mirror Lake. When we try by close observation to ascertain the cause of this contrast we discover, as Matthes has so well told us, that in the sculptural modification of the Valley by glacial erosion there has been a large element of control inherent in the structure of the granite, which is the prevailing rock. The granite originally solidified from a molten condition under a cover of immense thickness. This cover was removed by erosion ages before the uplift which gave the Sierra Nevada its present configuration. The relief of load, as erosion proceeded, and the lowering of the temperature of the mass as the granite was brought nearer the surface and eventually into the zone of erosion, greatly changed the condition of compressive strain which the force of gravity imposes upon the rock. This redistribution of strain caused certain portions of the mass to be overstrained, and relief was obtained by the development of systems of cracks or fissures which we call joints. These joints are in some cases straight and parallel so as to divide the rock into thick slabs, as on the face of Sentinel Rock. In other cases there are two or three intersecting systems which divide the rock into prisms, or cuboidal, or rhomboidal blocks. In still other cases the joints are curved and roughly concentric as at the Royal Arches. Many portions of the granite are, however, almost free from joints, or, if they be present, they are so widely spaced that they only slightly affect the integrity of the rock, as at El Capitan.

Now, nearly all of the vagaries of erosion, and particularly of ice sculpture, in Yosemite National

Park are referable to the erratic distribution of these systems of joints and to the disposition of the joint planes in each system. The ice, in passing over or past jointed granite, plucked out the blocks one by one and incorporated them within its body, carrying them forward with the glacial flow. In the course of time a vast quantity of rock was thus removed. In the unjointed portions of the granite in contact with the ice, on the other hand, erosion was limited to abrasion and comparatively little rock was removed by this process. In this way there were large differences in the rate of glacial erosion in near-by localities; and the same influence had also affected ordinary atmospheric and stream erosion in the ages that preceded the glacial period. The great salients like El Capitan are composed of granite in which the joint structure is but feebly developed and were, therefore, resistant to erosion by the dislodgment of blocks. The trough in which Bridalveil Creek flows above the falls is clearly conditioned by the intersection of inclined joints. The great steps over which Vernal Falls and Nevada Falls tumble are equally clearly determined by the disposition of the joint planes there. In the exfoliation of the curved slabs, so well exemplified in the Royal Arches, we have an excellent illustration of the control exercised by curved joints in the development of the great domes of the park, such as North Dome, Half Dome, and many others. The curious spires which are so common about Tuolumne Meadows, and which characterize the landscape in the wonderful view from the summit of Mt. Conness, owe their configuration to the same control of erosion by internal structure. It is well to note, however, that the curved joints which determined the configuration

of the domes and spires presented a structure which was not so favorable to dislodgment of spauls, whether by atmospheric agencies or by glacial plucking as was the structure formed by intersecting straight joints. The domes and spires represent portions of the granite which were, like the unjointed rock, relatively resistant to mechanical disintegration, so that, when the rest of the region was reduced in level, they remained as eminences. The higher domes and spires probably rose well above the surface of the great névé and the ice streams flowing from it, so that the exfoliation which gave them their present configuration is referable not to ice plucking, but to the heaving action of freezing water in the joint cracks, and to the slow, recurrent movements due to dilatation and contraction under varying temperature. Half Dome, the asymmetry of which, no less than its isolation and height, makes it so conspicuous a feature of Yosemite Valley, owes its peculiar configuration to the intersection of two systems of joints: a system of straight, vertical joints parallel to the flat west face, probably disposed in a narrow zone, and a system of curved joints concentric with the rounded east side.

Many of the lower domes have, however, been overridden by the ice and so have had a glacial modelling, by abrasion, imposed upon surfaces originally wholly determined by curved joints. In this process of glacial modelling great thick slabs of granite which had become loosened from the parent mass were plucked out by the ice, leaving vertical walls from a few inches to twenty feet or more high facing down stream. The ice immediately flowed into the reëntnants thus formed and abraded the new surface exposed to its attack by the removal of the slab. In

cases where this happened during the retreat of the ice front we find abundant manifestations of glacial scouring at sharply different levels on the bare rounded surfaces. Some extreme cases of this sort have suggested to Mr. Matthes that there may have been two glaciations of the region, and he has adduced other evidence in favor of this view. In this he is supported by the earlier interpretation of the moraines near Mono Lake by Russell; by the observations of Turner and Ransome in the Big Trees quadrangle; and by the later observations of Knopf on the eastern flank of the Southern Sierra Nevada. But the doctrine of two distinct glaciations of the Sierra Nevada is one which must be subjected to much more critical study before it can be accepted by geologists as an established fact. There is, of course, in this doubt as to the reality of two distinct glacial periods no objection to the recognition of frequent retreats and advances of the glacier front in one and the same glacial period; for we are familiar with such oscillations in the existing glaciers of Alaska, Norway, and the Alps.

Yosemite Valley differs from Tenaya Cañon in still other important features which excite not only geological interest, but also the wonder and admiration of all who come to the Valley. These are the waterfalls, the grace and beauty of which, no less than their great height, have made them famous the world over. Streams which flow with gentle gradients in comparatively shallow channels on the uplands corresponding to the old surface before it was uplifted, reach the brink of the Valley and plunge headlong into the abyss, clearing all contact with the cliffs for hundreds of feet. These upland channels which thus appear at the brink of Yosemite Valley as

small notches in its walls belong to the class of so-called "hanging valleys," which are rather characteristic of glaciated regions in general. They may have one of two different origins: 1. The relatively shallow upland channels may have been nonexistent prior to the glaciation of the region, the drainage having then taken some other path. In this case the present position of the streams was determined by the configuration of the surface vacated by the ice, and their channels, in so far as these have been cut by water erosion and not by glacial scouring, is wholly a post-glacial effect. If this be the explanation of Yosemite and Bridalveil creeks then there is nothing surprising in the fact that, in the short time since the ice vanished, they have eroded but shallow trenches in the glaciated upland, and so appear as hanging valleys on the brink of the Valley. 2. The upland creeks that now cascade into the Valley at Yosemite Falls and Bridalveil Falls may have been preglacial drainage lines which were temporarily occupied by the ice with the rest of the country, and which again became functional when their channels were vacated by the ice. In this case these two tributaries of the Merced must have been engaged in the work of stream erosion as long as the main stream and there should have been, just prior to glaciation, no glaring discordance in the depth of their trenches. If this be so, then the main cañon of the Merced at Yosemite Valley must have been very shallow just prior to glaciation, and nearly the whole depth of the Valley would have to be ascribed to glacial erosion. But we cannot accept this latter explanation because the cañon of the Merced below the limit of glaciation affords us the measure of preglacial erosion and tells us that Yo-

semitite has been only modified and over-deepened by ice work, but not, in its larger features, created by the glacier.

It would seem, therefore, that both Yosemite Creek and Bridalveil Creek are post-glacial drainage features; although the argument applies with greater force to the former than to the latter. The same interpretation can scarcely, however, be placed on Illilouette Falls, and much less can it be applied to Vernal and Nevada falls on the main flow of the Merced. These three magnificent cascades clearly are on lines of pre-glacial drainage, and their relation to Yosemite Valley is not the same as that of Yosemite and Bridalveil falls. The drop from Little Yosemite and that from the upland valley of the Illilouette to the floor of Yosemite are nearly the same, and the gorge into which the waters tumble in both cases is a glacially modified inheritance of a pre-glacial condition. Attention has been called to the fact that the uplift of the Sierra Nevada took place by two main elevatory movements, with a long period of rest between during which the high valleys of the Kern region were evolved to their present notable width. It may well be that on the drainage system of the Merced there were also similar high valleys carved out of the mountain mass, and that Little Yosemite and upper Illilouette are remnants of this old topography. Such valleys after the second uplift would, of course, be subject to vigorous dissection by reason of the accentuation of the stream grades. This dissection, however, probably proceeded as it does in plateaus underlain by flat lying strata; that is, by the recession of falls so well exemplified at Niagara and by the falls of the Yellowstone. At Niagara the

rocks are hard limestones resting on soft shales, while in the Yellowstone the strata are sheets of volcanic rock. But in both cases the gorge has been formed by the slow upstream recession of the falls. Horizontal jointing in the granite, such as is so well displayed near the top of Lower Yosemite Falls, and one third of the way up the walls of Hetch Hetchy, would have the same effect as planes of stratification in promoting this process of gorge cutting, particularly if combined with transverse vertical jointage, which would determine the verticality of the head of the gorge. Both horizontal and vertical jointage are well displayed in the gorge between Nevada Falls and the floor of the Valley.

We may thus picture to ourselves a pre-glacial Yosemite Valley, not as deep, nor as wide, nor as sheer-walled as the present Valley, but nevertheless a profound erosional gorge ending in spray filled *culs-de-sac* below both Little Yosemite and the high valley of the Illilouette, with great cascades in them not essentially different from those we see to-day with so much pleasure and interest. Nevada, Vernal, and Illilouette are, therefore, from this point of view, falls which handed over their work of extending the cañon of the Merced into the High Sierra to the Merced Glacier for a geologically brief time, and have since resumed operations at nearly the old stand. The amount of recession effected by the glacier was probably not great, since the work must have been done chiefly, if not wholly, by the process of plucking, and the paucity of the moraines below Yosemite indicates but a small product.

Pre-glacial Tenaya Cañon, in contrast to that of the Merced, was not extended upstream by a sapping

process, but by stream corrasion through granite traversed by a zone of vertical joints parallel to its length, and deficient in horizontal and in transverse vertical joints. The gorge was narrow and steep, and although it doubtless had its cascades, these did not have the sheer drop displayed by the Nevada and Vernal Falls. The deepening of the cañon by stream corrasion was more uniformly distributed throughout the length of the cañon.

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LIFE ZONES

OF

YOSEMITE NATIONAL PARK

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LIFE ZONES OF THE YOSEMITE REGION

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(Contribution of the Museum of Vertebrate Zoölogy of the
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THE "Yosemite section," embracing in that term the territory included between the eastern side of the San Joaquin Valley and the basin in which Mono Lake lies, may be considered to afford a fair sample of the fauna and flora of the entire Sierra Nevada. The following brief accounts of the life zones and of some of the vertebrate animals belonging to them may thus prove useful beyond the immediate limits of the Yosemite Park itself.

¹ For several years past the natural history of the Yosemite region has been the subject of special study by staff members of the California Museum of Vertebrate Zoölogy. This and the following three chapters are based upon the results of that study. Attention has been concentrated upon the mammals, birds, reptiles, and amphibians occurring within the section across the Sierra Nevada extending from Snelling in the San Joaquin Valley to Mono Lake, east of the mountains. This cross-section is at right angles to the main axis of the Sierras and is approximately ninety miles long and seventeen miles wide. It embraces Yosemite Valley and its environs, the lower canyon of the Merced River, and the country traversed by the Tioga Road; but neither Hetch Hetchy Valley nor the Mariposa Grove of Big Trees is included.

A total of 226 kinds of birds is now authentically known from the Yosemite section; there are 97 kinds of mammals, ranging in size from bats to bears, 20 kinds of snakes and lizards, and 11 kinds of frogs, toads, and salamanders. This makes, all told, a vertebrate fauna, outside of fishes, of 353 forms. This richness in number of kinds is due to the wide range of climatic conditions, with the depending vegetational features, covered in the Yosemite section. Only a small proportion of the total number of species occur together at any one level. The curious and interesting thing is that the changes in faunal constitution across the Sierras are not perfectly gradual but take place at intervals, abruptly. Several belts or "zones" of life result, in each of which conditions are relatively uniform. These belts have been described and named, and it is useful to know their names so as to be able to state the distribution of species in more exact terms than would otherwise be possible. These life zones are correlated roughly with altitude, and from bottom to top are called **Lower Sonoran, Upper Sonoran, Transition, Canadian, Hudsonian, and Arctic-Alpine**. As will be recognized at once, these zones are in the nature of temperature belts, the warmest at the base of the mountains, the coldest at the crest, on the highest peaks. It will be further seen that they correspond roughly to the transcontinental belts of climate, and that they bear names significant of their location—Sonora (in northern Mexico), Canada, Hudson Bay, etc. To outline very briefly the condition of affairs in the Yosemite section, let us begin at the west.

In following the Yosemite Valley railroad out of Merced, one traverses for the first hour the level floor of the San Joaquin Valley. From the train one sees

along the Merced River bottom numerous Fremont cottonwoods and valley oaks, and planted orchards of fig, orange, and olive, all indicative of the **Lower Sonoran Life Zone**. A day put in at a representative point, such as Snelling, would show the presence there of Mockingbirds, Texas Nighthawks, Blue Grosbeaks, Dwarf Cowbirds, Fresno Pocket Gophers, Merced Kangaroo Rats, Golden Beavers, and other exclusively warm-belt types of animals as well as of plants.

At Merced Falls the railroad enters the first foothills of the Sierra Nevada, and concurrently there appears with remarkable abruptness an entirely new set of trees and lesser plants, accompanied by as distinct a set of birds and mammals. The **Upper Sonoran Zone** has been entered and may always be recognized in distant view by the presence of digger pines, buckeyes, blue oaks, and interior live oaks, and by a host of bushy plants which constitutes the "California chaparral." This zone continues some fifty miles, all the way to El Portal, and up to an altitude of 4000 feet on south-facing slopes. Some of its distinctive species of animals are: California Jay, Northern Brown Towhee, Pallid Wren-tit, Plain Titmouse, California Thrasher, California Bush-tit, San Joaquin Wren, Hutton Vireo, Anna Hummingbird, Western Gnatcatcher, Bell Sparrow, Rufous-crowned Sparrow, Dusky Poor-will, Nuttall Woodpecker, Mariposa Brush Rabbit, Gilbert White-footed Mouse, Parasitic White-footed Mouse, Mariposa Meadow Mouse, Digger Pine Pocket Gopher, Heermann Kangaroo Rat, San Diego Alligator Lizard, and California Striped Racer.

At El Portal, on shaded, north-facing slopes, the visitor for the first time encounters the **Transition**

Zone, which is characterized by the yellow pine, Douglas spruce, golden oak, black oak, and incense cedar. This zone continues east throughout the Yosemite Valley, and rises on the walls of the Valley to about the 6000-foot level. A few Upper Sonoran birds and mammals reach up into the Transition, but for the most part an entirely new set predominates. But few of these are absolutely restricted to this zone; the greater number range farther upward, through the next one or two zones above. The more distinctively Transition vertebrates are: Band-tailed Pigeon, California Purple Finch, Black-throated Gray Warbler, Calaveras Warbler, Western Flycatcher, Black Swift, Pigmy Owl, Northern Spotted Owl, Northwestern Long-legged Bat, Boyle White-footed Mouse, Yosemite Pocket Gopher, and Coral King Snake. Some well-known species which range down into Transition from the zones above are: Blue-fronted Jay, Western Robin, Sierra Junco, Sierra Creeper, Short-tailed Mountain Chickadee, American Dipper, Sierra Hermit Thrush, Mountain Weasel, Yosemite Meadow Mouse, and Sierra Nevada Flying Squirrel.

At about the 6000-foot contour on any of the trails leading up out of the Valley, a rather impressive change is to be noted; the golden oak becomes replaced by the dwarf huckleberry oak, the California laurel and maple and black oak disappear, the Jeffrey pine replaces the yellow pine, and red firs and aspens appear. These mark the **Canadian Zone**. Birds encountered here are: Yosemite Fox Sparrow, Williamson Sapsucker, Sierra Grouse, Townsend Solitaire, Western Ruby-crowned Kinglet, Red-breasted Nuthatch, Cassin Purple Finch, California Evening Grosbeak, Lincoln Sparrow, Hammond Flycatcher, and Western

Goshawk. Among the mammals are: Navigator Shrew, Pacific Fisher, Allen Jumping Mouse, Yellow-haired Porcupine, Sierra Mountain Beaver, Sierra Golden-mantled Ground Squirrel, Tahoe Chipmunk, Allen Chipmunk, Sierra Chickaree, Tenaya Bluebellied Lizard, Mountain Lizard, and Sierra Alligator Lizard.



Life zones on cross-sectional profile of Yosemite National Park .

The **Hudsonian Zone** is the belt of forest just below timberline. It contains the lodgepole pine, which occurs commonly in the Canadian Zone, and has also trees of its own, namely alpine hemlock, silver pine, and white-bark pine. Birds become scarcer in this zone though mammals remain plentiful; some of the species extend up from the zone below. The California Pine Grosbeak, Mountain Bluebird, White-crowned Sparrow, Alpine Chipmunk, Belding Ground Squirrel, Sierra Marmot, Mountain Lemming Mouse, Gray Bushy-tailed Wood Rat, Yosemite Cony, Sierra White-tailed Jack-rabbit, Pine Marten, Wolverine, and Sierra Least Weasel are rather closely restricted to it.

The **Arctic-Alpine** is the highest of all the zones and covers the treeless area from about the 10,500-foot contour to the summits of the loftiest peaks. Only

one species of bird is confined to it, the Sierra Nevada Rosy Finch. Some of the Hudsonian mammals enter it locally; for example, Gray Bushy-tailed Wood Rat, Yosemite Cony, and Alpine Chipmunk.

It must be kept in mind that many of the vertebrate animals of the Yosemite section are not so closely restricted as the ones named in the preceding paragraphs. Certain species range regularly through two zones, for example, the Blue-fronted Jay; a few through three zones, as with the Sierra Junco, and in exceptional cases as many as five out of the six zones named are covered, as is done by the Red-shafted Flicker, Sparrow Hawk, and Western Chipping Sparrow. The last named was found by us summering in the orange groves at Snelling and also among the timberline trees in Mono Pass. It was, perhaps, more numerous on the floor of Yosemite Valley than anywhere else.

Other zonal contacts than those just given may be mentioned for the use of persons coming into the Yosemite National Park along the roadways or who may go on foot, on horseback, or by vehicle to other portions of the park. On the Big Oak Flat Road, the Transition Zone is reached in the vicinity of Groveland; Canadian is entered at Tuolumne Grove Big Trees and is left again near Tamarack Flat. On the Coulterville road, Transition is reached at the top of the grade three miles east of Coulterville, and this zone is traversed practically all the way thence into Yosemite. The Tioga Road begins in Transition, reaches Canadian just below Aspen Valley, touches Hudsonian on Snow Flat and enters it again at Lake Tenaya and continues in that zone until reaching Warren Fork of Leevining Creek. Tuolumne Meadows, Lyell Canyon, and Tioga Pass are all in the

Hudsonian Zone. The Wawona Road lies just at the upper margin of the Transition Zone for most of its course between Fort Monroe and Mariposa Grove of Big Trees.

The restriction of animals by "zones" applies particularly to the breeding season. Migratory species of both birds and mammals range more or less widely at other times of the year according to food requirements. Close adaptation of a species to a kind of food supply which disappears at the close of the summer season makes necessary search elsewhere for it in the winter time.

The study of the distribution of the animal life on the slopes of the Sierras is a fascinating one, especially when the student attempts to ascertain what the limiting factors may be; for it is certainly not in every instance temperature alone, up or down, which forms the barrier to the species. The intricate interrelations which we seek to understand are to be worked out only by patient and thoughtful study of the animals in their many and diverse environments.

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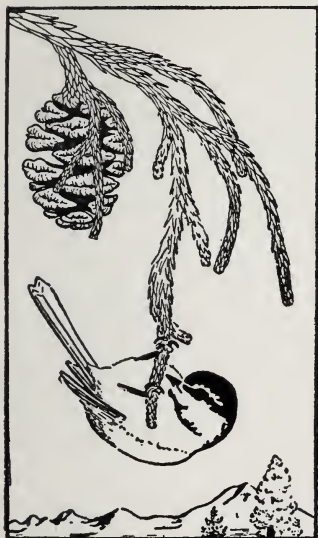
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SOME BIRDS



OF
YOSEMITE
NATIONAL
PARK

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SOME BIRDS OF YOSEMITE NATIONAL PARK

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(Contribution from the Museum of Vertebrate Zoölogy of the
University of California.)

THE West is often commented upon as a region scant in bird life, yet the "Yosemite section" alone, comprising an area of about fifteen hundred square miles, a little greater than that of the State of Rhode Island, has been found to harbor no less than 226 different varieties of birds. Of these, 199 are "full species." Nor are restricted localities within this area lacking in their quotas; Yosemite Valley, far off the general routes of bird migration, can already be credited with a hundred different kinds. Daily censuses checked by us hour by hour prove birds abundant there in early summer as to both species and individuals. A four-hour tally in Yosemite Valley on May 31, 1915, revealed 32 species and 220 individuals; a five hour walk in the western foothills near Pleasant Valley a week previously showed 48 species and 490 individuals.

Of all the birds in the Yosemite National Park the **Western Robin** least needs introduction. Soon after leaving El Portal on the stage, or upon entering the yellow pine belt along the Wawona, Big Oak Flat or

Coulterville Road, the visitor will catch sight of the familiar Robin as it forages in some open glade or sings from a perch in some roadside tree. It occurs throughout the mountain forest belt, in the Transition, Canadian, and Hudsonian zones, chiefly about grassy meadows and clearings. The mud-cemented nests are built for the most part in early May, and the spotted young appear by June. In fall and winter the Robins gather in flocks and wander widely as they seek out the then ripening berry crops. They desert the higher mountains at this season going to the foothills and lower valleys; after the first snow fall of the season, only a few remain in Yosemite Valley.

An associate of the Robin is the **Sierra Junco** or Snow-bird which does its foraging likewise around openings in the forest or along the banks of open flowing streams. The Junco has a black "cowl" covering head, neck and breast, a white-appearing bill, a dark back and wings, and white belly. As it hops about, the tail is opened momentarily and when the bird flies this member is spread widely, showing a conspicuous white margin which forms with the other features a ready recognition mark for the bird. The male Juncos sing from perches in the trees. Nests are built upon the ground where the birds seem not less successful in bringing off their young than the Robins which place their nests in trees. The Juncos stay in pairs during the summer, but they band together at the coming of fall and go to the foothills in flocks of twenty-five or more.

The Robin about ten inches long, and the Junco six inches from bill to end of tail, may be taken as standards of size comparison for other birds of the region. Both of these species are common in Yosemite Valley,



PLATE VIII

Male Western Warbling Vireo on the nest, singing while performing the duty of incubation. This is one of the common summer visitant birds of the Park

Photo by Henry J. Rust

and both range in fair numbers through the higher country nearly or quite to timberline.

A small Finch found numerously in summer in Yosemite Valley is the **Western Chipping Sparrow**. Smaller than a Junco, with a bright chestnut cap, a whitish line over the eye and streaked back, but plain under surface, it is sure to come early to attention, and in May and June its nests will be found in the pine saplings and deer-bushes on the Valley floor. The "chippies," like the Juncos, form into flocks before they depart westward and southward for the winter.

The small birds of bright and contrasted coloration known as **wood warblers** are important members of the Sierran avifauna. The **Audubon Warbler**, of varied body plumage but always exhibiting a yellow rump and white spots on the outer tail feathers, is the most widely distributed species of the group. It occurs in the coniferous trees of the Transition, Canadian, and Hudsonian zones during the summer, and winters in large numbers in the foothills west of the park boundary. This species both nests and forages twenty to fifty feet above ground in evergreen trees. A somewhat rarer species not occurring much above the Transition Zone is the **Hermit Warbler**, which has a dark body and rump, yellow head and black chin and throat. It forages amid the same sort of surroundings as the Audubon Warbler. When once learned, their songs, alone, distinguish them. The **Black-throated Gray Warbler** is a species practically restricted to the golden oaks which grow in profusion on the talus heaps and ledges along the north and south walls of Yosemite Valley. It is a bird of deliberate mien and drawling song and its coloration shows no obvious yellow. The other warblers of the

park are yellow-bodied in the main. In the willows and cottonwoods lining the Merced River from Snelling up into Yosemite Valley is the **California Yellow Warbler**. The black oaks of the Valley floor harbor the grayish-headed **Calaveras Warbler**, which seeks a site upon the ground for nesting, while in the moist thickets in the Yosemite is to be found the dark-“cowled” **Macgillivray** or **Tolmie Warbler**. In the Canadian Zone above the rim of the Yosemite gorge is the **Golden Pileolated Warbler**, a brilliantly yellow bird with a shining black crown patch. It stays in the creek dogwood and willows which grow in the wet meadows and along rushing streams. All of these warblers are absent from the mountains during the winter months; their food being almost exclusively of insects is available here in adequate quantity for their sustenance only during the summer season. Each of our Warblers has a set song delivered persistently in the spring months. But despite their cognomen of “Warbler” they do not compare as musicians with many of the other forest songsters in either quality, extent, or variety of song.

It is to be expected that “birds of prey” abound in a region so well stocked with the smaller birds and animals as is the Yosemite section. A dozen kinds of hawks and nine different species of owls have, indeed, been found here. Space limits us to detailed mention now of only a few of these. The **Golden Eagle** is supreme in size and in majesty of bearing among all the Sierran land birds. It is most common in the western foothills but is fairly well represented up into the highest passes of the Sierra Nevada. The Golden Eagle measures thirty to thirty-five inches in length, with a wing spread of six to seven feet. The least

glint of sunlight on the bird's head and neck reflects a golden brown tint, and this feature accounts for its name. The **Red-tailed Hawk** is found throughout the mountain country, and in summer the misnamed **Sparrow Hawk** visits the higher meadows and ridges even above timberline to search for grasshoppers.

The clear cool mountain air lulls so many Yosemite visitors to an early sleep that only the exceptional person will note the flitting forms or measured hoots of any of the owls in the region. The smallest of these birds, the **California Pigmy Owl**, is perhaps the most likely one to be heard, because it begins calling at early dusk and often continues in voice long after daybreak. It is only about seven inches long, has a rounded head without ear tufts, yellow eyes, and a dark brown back. It inhabits sparse woods and is the commonest owl in Yosemite Valley. Its call is quite distinctive, a trilled tooting which lasts several seconds, a pause, then a single note, another pause and then a second note, *too-too-too-too-too-too-too-too; whoot; whoot*. Sometimes a deep reverberant *whoo, whoo, who-hoo* comes from the taller trees, indicating the presence of the big **Horned Owl**; and on occasion one may hear, in Yosemite Valley, the dog-like yelping and barking of the rarer **Spotted Owl**.

The Yosemite visitor who has read John Muir's splendid and appreciative description of the **Water Ouzel** or **Dipper** in his book *The Mountains of California* will be keen for a personal acquaintance with this singular inhabitant of the Sierran creeks and rivers. A morning along any of the streams in the park is likely to reveal a chunkily built bird of slaty gray coloration which is jouncing about this way and that on some rock in midstream or flying from one such

perch to another. Suddenly, the bird disappears beneath the stream, and one wonders with apprehension at its fate in that rushing torrent; but speculation is dispelled when the Dipper reappears in a few seconds up or down stream and resumes its "dipping" on another rock. This one-time land bird, relative of the wrens and thrushes, has taken to living about, *in* and *under* the water. Its nest is placed along the stream, usually in a niche of the rock where touched by light spray, so that the mossy exterior of the structure is kept wet and growing while the birds are rearing their brood. The Dipper's song is among the most striking of all mountain bird voices, and while given through much of the year, it appeals best when other songsters are gone or quiet, during the snowy winter.

The swift flowing waters of the Merced and Tuolumne rivers offer attraction to but few water birds, but wherever the banks are low and covered with sand or gravel there may be expected the **Spotted Sandpiper**. Lagrange, Yosemite Valley, and Tuolumne Meadows are but three of its several known haunts within the Yosemite section. In summer the pairs are busy with their nesting duties, and their clear calls ring out at all times of the day as the birds trot along the strand or fly in semicircular course from place to place along the shores in search of food. These are typical "shore-birds" and their nest consists of little more than a depression in the gravel large enough to shelter the four good-sized eggs.

The mountain forests furnish the homes of many different kinds of **Woodpeckers**. The Yosemite section has thus far revealed no less than twelve species, some in the foothills, some in the high mountains, others encompassing both these habitats. At middle

altitudes, in Yosemite Valley and the Canadian Zone above, is the **White-headed Woodpecker** which is solidly black except for a pure white head and small patch of white on each wing. It might be thought that a bird of such coloration would be conspicuous, but the very reverse is true; these colors blend exceedingly well with the background whether this be formed by the bleached or blackened stumps, or the high lights and shadows on the living trees. The Whitehead nests usually within twelve feet of the ground, by preference in a shattered stump or in an upstanding branch of a prostrate trunk. During the late spring and early summer months its domestic program is thus capable of easy study.

"Cock-of-the-Woods" is an appropriate name given to the **Pileated Woodpecker**, the giant among all the local Woodpeckers. It measures over seventeen inches in length as compared with the twelve inches of the well-known Red-shafted Flicker. A bird of black body, it shows white in large patches on both outer and inner surfaces of the wings and a stripe of white on its neck, while the head bears a flaming red crest. This Woodpecker occurs at times in Yosemite Valley, but his kind is more abundant in places of greater altitude where there are numerous dead stubs of red or white fir to be prospected for grubs or, in spring, to be excavated for nesting places. When at work the noise produced by the Pileated's big chisel-like beak sounds like the strokes of a distant woodchopper or the blows struck by a telephone repair man. When on the wing the Pileated Woodpecker pursues a nearly level course, flashing the white wing patches regularly, and often uttering a sustained and far-carrying *kuk-kuk-kuk-kuk-kuk*.

The **California Woodpecker**, so common in the California valleys and foothills, reaches the oak-dotted floor of Yosemite Valley in fair numbers, and its work may be seen in many places there. This is "el carpintero" of the Spanish explorers, the bird which stores for itself a supply of acorns, wedging each into a newly dug pit in the bark of some convenient oak or pine tree. Certain big trees in Yosemite Valley are studded with acorns for many feet from the ground. With golden oaks on the talus slopes and black oaks on the Valley floor the birds should never be at a loss for their favorite nuts. Yet another type of food is needed, for in summer they are regularly to be seen flying out from exposed perches to capture passing insects.

Over the open gorge of the Yosemite and from most of the "inspiration" points about the rim, may be seen every day of the summer season, the "policemen of the upper air," the **Swifts** and **Swallows**. The dark-bodied form, of crossbow outline, which cuts the air at lightning speed is the **White-throated Swift**, and its more leisurely associate, which displays a pure white under surface, is the **Violet-green Swallow**. The Swift is of about twice the bulk of the Swallow, its proportionately narrower wings are concave instead of straight-margined behind, and it is much more swift and daring than the Violet-green; when flying it often utters a torrential series of notes louder and more hurried in delivery than any calls given by swallows.

The **Band-tailed Pigeon**, western counterpart of the now extinct Passenger Pigeon, is found in fair numbers in the Yosemite region practically throughout the year. Yosemite Valley harbors one or more flocks of these birds, and while acorns constitute their

main source of food, toyon and coffee-berries, and scattered grain in the poultry yards of indulgent residents of the Valley afford the birds forage when the first named staple is scarce or wanting. The bluish gray back, pinkish breast, and dusky-banded tail are color features to be looked for. The big birds are often unnoticed amid the oak foliage until they flush with a loud clapping of wings and make off in swift course to some other retreat.

At the lower limit in scale of size among Sierran and indeed all Californian birds is the **Calliope Hummingbird**, the little green and violet-feathered jewel, which flits lightly about the flowers of the mountain meadows. This midget, weighing about one-tenth of an ounce (3 grams), is but a summer visitant here and winters in Mexico. The thickets of Sierran currant break into blossom in the Canadian Zone during May or early June. The Calliopes at the same time appear in numbers, the males foraging and battling with one another on the upper slopes while the females stay down toward the canyon bottoms preparing to rear their broods. The "gorget" of iridescent hues on the throat of the male consists of long lance-shaped feathers which in display are held out apart from the snowy white color of the neck. This is the only Hummingbird which, so far as we know definitely, nests in the park; the **Anna** and **Black-chinned** occur in the western foothill country as far up as El Portal, and the **Rufous Hummingbird** passes south along the Sierras in July and August.

From early morning until late dusk, throughout the mountain forest belt, is to be heard the droning *zuweez* of the **Western Wood Pewee**. This is the commonest and most widely distributed member of

the flycatcher family although other species of the group occur in numbers in appropriate places in the Yosemite section. The Pewee is a bird of open forest, usually perching fifteen to forty feet above the ground in a place where it has a clear view of its surroundings. The bird sits quietly, but its head turns this way and that as it watches for passing insects. These are captured by short quick sorties, the Pewee returning to the same or a nearby perch after each pursuit. The Pewee is plain dark brown above and on the sides of the body, with yellowish white on the middle of the lower surface. The larger **Olive-sided Flycatcher** which chooses the lofty tree-tops as lookouts has whitish flank patches and a loud three-syllabled call; and the small weak-voiced flycatchers have light eye rings and light bars on the wings.

About the same time that the newly arrived visitor sees his first Robin, another, even bolder member of the mountain avifauna will likely force itself upon the attention. This is the **Blue-fronted Jay**, local representative of the crested or Steller Jays of western North American generally. It is a common resident of the Transition and Canadian zones of the park. The bird spends most of its time in the trees; a favorite perch is near the top of a tall conifer from where it can see all that goes on in the forest. When ascending to such a station the bird will keep close to the trunk, hopping up and around from one branch to another as if following a spiral staircase. In nesting time the two members of a pair keep close together. While ordinarily noisy, a "zone of quiet" is maintained about their own nest. At this season they are wont to raid the nests of smaller birds carrying off the eggs or young to serve for their own food; the small parents



PLATE IX

The Water Ouzel

Photo by Gertrude Metcalfe Sholes

know this, for whenever a piratical jay approaches they at once set up a remonstrant calling that attracts sympathizers from far and near.

The "high Sierra" has its component of bird life, smaller to be sure in both species and numbers than the lower, more thickly wooded areas, but containing a number of distinctive types worth a long hike to get acquainted with. The **Clark Nutcracker**, a member of the Crow Family, and the local "camp robber," is a denizen of the Hudsonian Zone, sometimes ranging down to the upper limits of the Transition, and again and more often up above timberline. It wears a pied plumage, gray on the body with black flight feathers, while each wing shows a white spot, and the tail a broad white margin when the bird takes to flight. The daily round of foraging after pine seeds either in the trees or on the ground beneath soon results in the plumage acquiring a brownish overtone due to pitch, and after the birds have gone through with the duties of the nesting season (March to May) some individuals present a bedraggled appearance indeed.

Early summer visitors to the Canadian Zone are likely to hear a song of exquisite beauty coming from the top of some lofty fir or pine. Interspersed between the warbling strains are numerous metallic clinking notes resembling a ground squirrel's whistle. All of these are from the repertoire of the **Townsend Solitaire**, in several respects an unique member of the Thrush Family. The Solitaire is a grayish bird of slender form and long tail. When it takes to flight one sees a light margin to the outer tail feathers and a broad yellowish bar upon each open wing. One would search the trees in vain for this bird's nest; the tree-tops are used only for singing and foraging. At nest-

ing time a sheltered spot on the ground is selected, such as the base of some uprooted tree or a niche in a roadside bank, and here a nest of loose construction, with many pine needles and twig-ends straggling below it, is placed. In the fall the Solitaires range over the country widely, going here and there after berries of juniper, toyon, and mistletoe, which furnish their sustenance in the colder months of the year.

Two **Thrushes** occur in the region during summer, the larger and more plainly garbed **Russet-backed**, rather sparingly and chiefly in the Transition Zone, and the **Sierra Hermit Thrush**, vesper songster in the wooded glades, which is found in Yosemite Valley but more commonly in the zones above. The latter, told at once by its rather bright "rufous" rump and tail, has a peculiar habit of twitching or refolding its wings at short intervals and slowly depressing the tail at the same instant. It keeps close to the stands of small dense conifers in canyon bottoms whence its song of set theme but much varying key comes at short intervals, especially in the morning and evening hours of twilight.

The Sierras possess three distinct **Grosbeaks**, two of which are resident at high altitudes practically throughout the year. In the Hudsonian Zone is the rather rare **California Pine Grosbeak**, a gray bird of slender appearing body and long tail. The females and young are "washed" with yellow on the head and breast while the adult males are brilliant red over nearly the entire body. In the Canadian and Transition zones one is likely to see the more chunkily built and vari-colored **California Evening Grosbeak**. This bird has a huge greenish yellow bill. The body plumage of the male is yellow, the tail and wings black

with a large patch of white along the inner margin of each wing. The female is gray with scattered white markings on the dark flight feathers. Neither of these Grosbeaks is an elaborate singer; their best efforts are little more than a repetition of the high-pitched call notes.

The **Black-headed Grosbeak**, one of the largest and most strikingly colored of the finch and sparrow tribe, has gained a special reputation in Yosemite Valley by reason of its habit of appropriating butter and other viands from tables set beneath the trees. The plumage of the male is varied with black, brown, and white, while the female is much streaked, especially about the head. In May and June these Grosbeaks are in full voice in Yosemite Valley. Novices confuse the song of this Grosbeak with that of the Robin, but the former is fuller and quicker, with many little trills and warbles not heard in the Robin's rather monotonous carol. The Black-headed Grosbeak builds a simple nest, little more than a cupped platform of fine interlacing twigs, and often so thin that an observer standing on the ground can look through the bottom and see at least the outline of whatever it contains.

The brush belt of the Canadian Zone with its manzanita, snow bush, chinquapin, and huckleberry oak is the home of a big, ground-dwelling type of Finch, the **Fox Sparrow**. Winter or summer, birds of this sort are there, though the race represented, and of course the individuals, change with the season. In summer there is the grayish toned race called **Yosemite Fox Sparrow** while winter sees this variety replaced by brown backed birds from the Alaska coast. All are alike in being ground foragers, who kick and dig with their stout feet in the leafy waste, sending up little

jets of débris with an accompanying noise out of all proportion to the size of the bird, and such as sometimes frightens timid walkers along the trails who suspect some lurking wild beast. Passing these thickets in summer one is apt to hear the clear ringing lay of the bird, and if one camps near a ridge top touched early by the morning sun, he will likely be awakened by the songs of the Fox Sparrows who have moved upslope to catch these first warming rays after a chilly night.

Often while traversing trails through open forest, there comes from the tree tops a quaint, nasal *weh, weh, weh*—syllables which sound like the blasts of an elfin horn. Search as he may, the traveler will at best locate a small form moving about the trunk and limbs near the tiptop of the tree. If luck and patience favor, the bird may come low enough so that its grayish back, black head with light stripe over eye, reddish under surface, and very short squared tail show it to be a **Red-breasted Nuthatch**. The bird forages exclusively on the bark, hunting out insects which have secluded themselves in crevices. In moving about, the Nuthatch goes either up or down, with seemingly equal facility. The **Slender-billed Nuthatch**, western relative of the White-breasted of the East, occurs at lower altitudes, and occasionally, in the yellow pine belt, a troop of the **Pygmy Nuthatches** may be encountered.

Each part of the tree receives attention from some particular type of bird. Kinglets and Warblers search the foliage, Vireos the smaller twigs, Woodpeckers seek grubs buried within the wood, while Nuthatches and Creepers scrutinize the bark of trunk and limbs. The **Sierra Creeper**, the local variety of an almost world-

ranging species, is found on the forest trees of the Transition and higher zones. The Creeper wears a streaked brown pattern of color on the back and the under surface is white; its tail feathers are long-pointed and stiffened so as to give the bird support as it clings to the side of a tree. Unlike the Nuthatch, the Creeper moves only upward on the trunk; it ascends from the base, often spiralling around the trunk, and when it arrives at the top of one tree it flies off to the base of another. Its call is fine and wiry and the song is but little more than several of these faint high-pitched notes in quick succession.

Chickadees are associated in the mind with forests, and in the Yosemite region is to be found the **Mountain Chickadee**, inhabitant of the woods, throughout the Transition and Canadian zones. Memories of the plainly pronounced *chick-a-dee-dee* and of the clear whistled song remain long in the minds of travelers who visit the California Sierras. In fall and winter the birds go about in companies but in spring these companies break up into pairs, and by early May the nesting duties are begun. First comes selection of a nest site, usually an old hole of the White-headed Woodpecker. This chosen, it may be remodelled or cleaned out somewhat, when it is lined with feathers and hair, and then five to eight eggs are laid. When the brood is hatched and grown they fairly fill the cavity, and anyone who has taken out a family of Chickadees to make their portraits will attest to the impossibility of being quite able to fit them back into the nest hole again. The Mountain Chickadee remains in the Sierras through the winter, and its familiar call is one of the few bird notes to be heard when the Yosemite Valley is blanketed with snow.

Along the streams at middle altitudes in the Transition and Canadian zones one is sure to hear, during the early summer months, the pleasing song of the **Western Warbling Vireo**. Many birds sing only at morning and evening, a few chiefly during midday, and some of those who keep up their songs and calls throughout the day soon weary the human hearer; but all this does not apply to the Western Warbling Vireo. Even during afternoons of drowsy heat we have heard these birds in almost continuous song. Singing does not hinder the birds in the performance of their regular duties, for we have seen one carrying material and building its nest while it sang, and it is commonly known among bird students that this Vireo sings regularly while sitting upon its eggs.

The open grassy areas of the Hudsonian Zone, such as those which constitute Tuolumne Meadows, afford an abundant supply of insect food for a brief period during the summer months, and several birds migrate to these high mountain locations to take advantage of this ephemeral food supply. The **Mountain Bluebird** is one of these summer visitants to the high Sierras. Paler in tone of blue than either its relative of the California foothills or the Eastern Bluebird, this species in its coloration reflects the intense lights and pallid tones of the high mountains. When the first mountaineers of the season reach the alpine meadows, pairs of Mountain Bluebirds are preparing to nest, seeking old woodpecker holes or similar cavities of dead trees. By July the young are hatched and then the parent birds busy themselves hunting insects in the fast growing grasses of the meadows. A favorite method with this bird is to hover in one place with rapidly beating wings ten to twenty feet

above the ground and intently scan the turf below for prey. When an insect is spied the bird drops rapidly to the surface, captures the object and then makes off with it to a perch or to the nest.

From well up in the forest trees there comes during the spring and early summer a clear song of considerable volume which seems to say, *O, Oh-Oh, Cheerily, Cheerily, Cheerily*. One would be tempted to look for a bird of considerable size, but the songster is actually one of the smallest in the mountains, the **Ruby-crowned Kinglet**. There are two species of the diminutive Kinglets with bright crown markings, in our mountains. The Ruby-crown has a red crown patch present only in the male. This is normally concealed by the other feathers of the head but can be flashed forth with startling effect when the bird is excited. The **Golden-crowned Kinglet** on the other hand wears a yellowish crown patch bounded by black. It is present in both sexes and in both is held permanently in view. In addition to its pleasing song, the Ruby-crown gives a loud sputtering note or "ratchet-call" which it utters when excited over any unusual event such as the appearance on the scene of a Bluejay or Owl.

Surely the visitor who really looks for birds in the Yosemite region will not be disappointed. For the experience of those who have already made fair trial has proven the richness of the possibilities here. And these possibilities are far from exhausted; new discoveries are sure to reward careful search for many seasons to come.

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SOME MAMMALS OF YOSEMITE NATIONAL PARK

BY JOSEPH GRINNELL, *Director*, and TRACY IRWIN STORER, *Field Naturalist, Museum of Vertebrate Zoölogy, University of California*

(Contribution from the Museum of Vertebrate Zoölogy of the University of California.)

THE Yosemite region possesses an abundant population of mammals both as to species and individuals. A total of ninety-seven different kinds is definitely credited to the region. Subtracting three species known to be extinct, and eight varietal forms, we have record of eighty-six "full species" now to be found between Snelling and Mono Lake. The determination of the population as to individuals is more difficult with mammals than with birds, and has been attempted in only a few places. In so far as data have been assembled it is estimated that mammals exist throughout the country at large in the ratio to birds of ten to one.

The average visitor, nevertheless, sees much less of mammals than of birds. Squirrels and Chipmunks are out during the daylight hours, and occasionally a Bear or Coyote or a group of Deer is observed, but the presence of most other mammals must be ascertained by noting their "sign," tracks, and workings. Foot-prints of Badgers, Wolverines, and Mountain Lions may be seen in trails and roadways, or on snow; gnawed

tree trunks give evidence of Porcupines; and earth mounds of different sorts indicate the presence of Moles and Gophers; but the host of small species of Mice and Shrews leave less evidence of their presence than any of the above, and only assiduous trapping (which can be done in the park only under special permit for scientific purposes) will reveal the abundance and variety of mammalian life which is active during the hours of darkness.

Among all this multitude of mammals there is not one species which need be feared by visitors on the ground of personal violence. Bears in search of food will sometimes raid camps at night, especially when the occupants are away, and Mice and Chipmunks will gnaw into stores of provisions, but these temporary inconveniences, if they are experienced at all, are certainly far more than offset by the pleasure to be gained in observing the ways in which these diverse types of animals carry out their several existences.

The **California Gray Squirrel** will be one of the first mammals to attract the attention of the visitor to Yosemite, for it is fairly well represented in the Transition Zone forests which are traversed by the several roadways leading into the mountains from the west, and it is common among the trees on the floor of Yosemite Valley. The Gray Squirrel is typical of the tree dwelling members of the squirrel family. Its lithe body, strong legs, and long, heavily bushed tail all enable it to jump readily from branch to branch, while the sharp curved claws enable it to cling securely to the bark of trunk or branches. The Gray Squirrel is active practically throughout the year, so that visitors at whatever season will see the species; however, more individuals are out in good



PLATE X

Rocky Mountain Mule Deer, the only species of hoofed big game now to be found in Yosemite National Park.

Photo from habitat group, California Academy of Sciences, San Francisco

weather than during times of heavy snow. These animals find their usual forage in the acorns of several kinds of oaks and in the cones of the pines, particularly those of the yellow pine. From the time that the first cones reach full size, in early summer, until the last seeds are matured in late fall or early winter, the Gray Squirrel pays devoted attention to the cone crop as long as this holds out. The squirrels ascend the trees and cut the cones loose from the branches. No effort is made to hold onto them at this time, and the heavy green cones come hurtling down and strike the ground with a force that is, to say the least, disconcerting to persons who may be walking near or under the trees. After cutting off one or more cones, a squirrel will descend to the ground and proceed to open up a cone. Sitting up on its haunches and steadying the cone in its forefeet, the animal gnaws off the scales which protect the seeds, beginning at the base of the cone. Like other rodents or "gnawing" animals, the Gray Squirrel is provided with two opposed pairs of stout chisel-like teeth in the forepart of its jaws, and these serve to cut quickly through the tough bases of the scales. In a surprisingly short time the cone is reduced to a core and a heap of scales while the squirrel has consumed the stock of seeds or nuts or stored them in part within its cheeks. The ground beneath "fruiting" pines is often strewn thickly with piles of these "table scraps" from numerous feasts.

At other times of the year the Gray Squirrel lives on a variety of vegetable materials, especially upon acorns, many of which are buried in the ground in the fall. In the spring it sometimes turns its attention to the eggs and nestlings of birds which nest in trees. The birds recognize the squirrel as a possible enemy

and are quick to set up a disturbance whenever a Gray Squirrel appears in the near vicinity of their nesting precincts.

The Gray Squirrel population in Yosemite Valley seems somewhat larger than in like territory elsewhere. This may be due to the additional food available about houses and camps as well as to the abundance of oaks and yellow pines there. An estimate made in Yosemite Valley during October, 1914, placed the numbers of the Gray Squirrel at one per acre. The Valley, below the 4250-foot contour, and from "The Gateway" below Cascades eastward, contains about seven and a half square miles. This would give a total Gray Squirrel population, in the fall, of 4800, which is believed to be considerably in excess of the numbers to be found in any equal area in the open woods of the Transition Zone elsewhere.

In the forests of the Canadian and Hudsonian zones lives the **Sierra Chickaree**, a "red" squirrel similar in general habits to the Gray Squirrel but of smaller size and different coloration. The Chickaree is dark brown tinged with reddish on the upper surface, has a black line along each side of the body, and the lower surface of the body is white or buffy white. Its body is about eight inches long and the moderately bushy tail five or six inches. The mode of life of the Chickaree is similar to that of the Gray Squirrel. It is a dweller in the trees and comes to the ground only when necessary to retrieve a fallen cone or to cross an opening not bridged by overhead branches. Where trees are close together as in many parts of the lodgepole pine forest, the Chickaree literally lives in the trees.

The food of this species is similar to that of the Gray

Squirrel but not so varied; there are no large oaks and but few nut producing plants within the Chickaree's domain. It must perforce live more extensively on the seeds of cone-bearing trees. The Chickarees which dwell in the Canadian Zone where firs are abundant may be seen in the fall assiduously gathering the thin-scaled cones of the red and white firs. These are "cachéd" by being buried along the sides of some large log near the squirrels' home tree. When the snow comes the cones gain further protection, in cold storage as it were, whence they are drawn upon and used by the Chickaree, as need be throughout the winter. In the spring observant travelers will find the logs strewn with the scales and cone-cores discarded by the squirrels during their meals. The voice of the Chickaree is decidedly different from that of the Gray Squirrel and is also much more varied. One common call is a prolonged trill of high pitch; and there is a striking single note which is given from time to time with an insistent delivery.

There are seven species of small striped **Chipmunks** in the Yosemite section, and five of these occur within the Park boundaries. All agree in general pattern of markings, having the head and back marked with alternate stripes of dark and light color and with more or less bright brown along the sides, but there are decided differences in tone of coloration. There are also considerable differences in size, habits, and local distribution of the several species.

Chipmunks in general are nimble creatures, to be seen scurrying about in their eager search for food, at frequent intervals playing with one another or fleeing from supposed or real enemies. There is a distinctive sort of quick intermittent or "jerky" movement on the

part of a chipmunk, in which the animal will move a few steps and then be absolutely still for several seconds, save perhaps for a sideward switching of the bushy tail. In these short intervals of quiet the streaked pattern fairly melts into the animal's surroundings so that the eye may lose the creature for the moment altogether. Sudden changes of position are often each accompanied by a single exclamatory note. If a Chipmunk becomes thoroughly frightened it makes off pell-mell and in direct course toward its retreat, scarcely looking behind, and uttering a torrent of excited chippings as it goes.

The usual note with all of the species is a high pitched *psst* which is often repeated to form a sputtering series. The larger species have also a hollow low-toned *pook* which may be likened to the bark of a dog, as it is given with rather long rests between successive notes.

Each species of Chipmunk has a definite general range and a particular "niche" within this range; no two species are found in exactly the same surroundings.

On the west slope of the mountains in portions of the Upper Sonoran and Transition zones containing mixed chaparral and trees there is the **Mariposa Chipmunk** (*Eutamias merriami mariposæ*) a large dark grayish species. It is found in small numbers in thickets along the north and south walls of Yosemite Valley.

The most widely distributed and commonest species of the Yosemite region is the **Tahoe Chipmunk** (*Eutamias speciosus frater*) which occurs throughout the Canadian and Hudsonian Zones. It may be known at once by its small size (total length about eight inches), bright highly contrasted pattern of coloration, extremely lively manner, and especially by



PLATE XI

Mountain Lion or Cougar

Photo from habitat group, California Academy of Sciences, San Francisco

its habit of seeking safety high in the trees, rather than in logs, thickets, or rock heaps. Tahoe Chipmunks have been seen fifty feet or more above the ground, while none of the other species in the high mountains goes much if any over five feet from the ground.

The Canadian Zone possesses also a rather large species of predominantly grayish coloration, the **Allen Chipmunk** (*Eutamias senex*). This one lives about boulders, fallen logs, and brush patches. In the upper part of the Transition Zone and the lower portion of the Canadian there is a species of about the same size and practically the same habits as the preceding, but with much taller ears and a conspicuous white spot at the hinder base of each ear. This is the **Long-eared Chipmunk** (*Eutamias quadrimaculatus*), almost as brightly colored as the Tahoe Chipmunk. The smallest and palest-colored species within the park is the **Alpine Chipmunk** (*Eutamias alpinus*) which dwells among rocks and fallen trees in the Hudsonian Zone. It is the timberline chipmunk, the last to be seen during an ascent of Mount Lyell or any of the other loftier summits.

All of the chipmunks living above the snow-line (about 3300 feet) in the Yosemite section hibernate for longer or shorter periods of time in winter, although their larger relatives, the Gray Squirrel and Chickaree, are active throughout this season, retiring only on very stormy days.

There is one member of the squirrel tribe which is observed by very few Yosemite visitors. This is the strictly nocturnal **Sierra Nevada Flying Squirrel**, the only local mammal except the bats which is able to travel through the air. The word "flying" is here

used inaccurately, as this squirrel is only able to vol-plane from a high perch to a lower one. Its body is flattened, and between the fore and hind leg on each side there stretches a furred double layer of skin which adds to the animal's spread and makes feasible its oblique passage through the air. Its dense silky hair seems to be an adaptation in this direction and also contributes to the quietness of its "flight." The Flying Squirrel lives in the Transition and Canadian Zones, being fairly common in the black oaks in Yosemite Valley and in the red firs above the Valley rim.

All of the members of the squirrel kind mentioned in the preceding paragraphs are species which live and find shelter chiefly or entirely in trees or logs; but there are also important members of the group which dwell upon and beneath the ground. These are the Ground Squirrels and the Marmot. The **California Ground Squirrel**, of brown tone of coloration with whitish shoulders, is in habits the western counterpart of the Prairie Dog and is found, in the Yosemite region, from the San Joaquin Valley up to an altitude of 8200 feet in the mountains. In the Canadian and Hudsonian zones is the **Sierra Golden-mantled Ground Squirrel**, locally called "copperhead." This species has the head and shoulders golden yellow while the body is marked along each side with two jet black stripes enclosing one of pure white. The "niche" of this species is in the open forest about bases of large trees and rocks. The Hudsonian Zone supports another burrowing species, the **Belding Ground Squirrel** or "picket-pin," a rather plainly garbed animal of yellowish brown coloration and with a reddish wash along the back. It lives altogether in the meadows where it finds abundant forage during the summer

months and where it may often be seen sitting up in characteristically erect posture on the lookout for danger.

The Golden-mantled and Belding Ground Squirrels hibernate regularly and so do those representatives of the California Ground Squirrel which live in the Transition and Canadian zones where snow lies on the ground during the winter months. All of these rodents feed to repletion during the summer and by fall their bodies are heavily stocked with fat which then serves to warm and nourish them during the long winter sleep.

The **Sierra Marmot** (*Marmota flaviventer sierræ*), often called "Woodchuck," is the largest local representative of the squirrel family in the Yosemite region. In bodily configuration the Marmot is stouter than the other members of the family, with proportionately shorter legs and tail. It is not infrequently mistaken for the badger, a totally different animal which, however, often lives in the same sort of country. Adult Marmots measure 15 to 18 inches (head and body), with the tail 5 to 8 inches long, while the weight ranges from 4 to $6\frac{3}{4}$ pounds with different individuals. Here in the Sierras the Marmot is a high mountain animal, dwelling chiefly in the Hudsonian Zone. The winter months (from about October until May) are spent in hibernation. Each Marmot has a burrow in the ground, usually beneath some huge granite boulder at the edge of a meadow or at the base of a tree at the margin of the forest. On all pleasant days the Marmots are out during the warmer hours, either foraging in the grass of the meadows or resting near their burrows. During the summer months the Marmots must eat not only to supply their daily needs but also

to take on fat to carry them through the long winter. It is not an uncommon experience during this season to come upon one of the animals out some distance from its burrow and busily engaged in cropping the new grasses. If frightened while so engaged the Marmot will make off with a lumbering gallop toward its burrow. When not feeding, the animals spend much time sunning themselves on the tops of bowlders or at the mouths of their burrows. In any situation, when alarmed, the Marmot utters a shrill bark or whistle. Sometimes it stands up on its hind legs to get a better view of the object which it is keeping under surveillance.

The **Rocky Mountain Mule Deer** (*Odocoileus hemionus hemionus*) is the large mammal most likely to be seen by the Yosemite visitor. In early days, when white men first thronged the Sierran foothills in search of gold, no less than four species of horned or antlered big game animals inhabited the Yosemite region. The San Joaquin Valley marshes supported the **Tule** or **Dwarf Elk**; the plains both east and west of the Sierras were the ranges of the **American Antelope**; the high Sierran crest was the habitat of the **Sierra Mountain Sheep**, while on the intervening slopes of the mountains there lived the **Mule Deer**. The first three have vanished from the Yosemite section, probably never to return, but the Deer are still present in goodly numbers. Deer are present in the park throughout the year, though their local distribution changes with the season. In the summer time they are more common in the higher zones and many are to be seen at Chinquapin, above Yosemite Falls and in the vicinity of Merced Lake, and a few wander above timberline along the Sierran crest. With the



PLATE XII

American Black Bear amid the yellow pines in Yosemite Valley

Photo by J. T. Boysen

coming of winter they are forced to lower levels and concentrate in that season in the upper foothills along the western boundary of the park. At all times of year they find their forage chiefly among the bushy plants, most especially the various species of deer brush or mountain lilac (*Ceanothus*). Our Deer do not habitually graze in meadows.

The Mule Deer gains its name from the large size of its ears, which are about eight inches long and four inches across. The tail lends further character to the suggested comparison, for this member is slender and nearly devoid of hairs toward the base beneath. In the summer months the Deer wear a thin reddish colored coat, which is acquired in June and carried until October; then the thick gray pelage of winter is assumed.

The fawns of the Mule Deer are born about the first of July, but the does keep their charges hidden until a month or so later, after which time the young in the spotted reddish coats are seen rather commonly. The usual number at a birth is two, though single fawns are often seen and rarely there are three young. The young run with the mother until the following spring or until they are "yearlings." Then she deserts them to prepare for the new litter.

The Deer in the park have responded favorably to protection from hunting, and large bands are seen there during the winter months. Some pass through Yosemite Valley but the larger migratory movements are along the ridges above.

Discussion of Deer leads logically to mention of their principal enemy, excepting man, the **Mountain Lion** or **Cougar**. Save for the **Wild Cat** or "Lynx Cat" (two names for one and the same species) there is no

other member of the cat tribe here; there are no Canada Lynxes in the Sierra Nevada. The Mountain Lion when fully adult measures about $6\frac{1}{2}$ feet from tip to tip, of which about thirty inches is the tail. The body coloration is usually reddish brown, sometimes gray. The only difference between males and females is in size, the former being the larger. Mountain Lions are so wary that but few are seen under ordinary circumstances. Many persons have lived in the mountains for years without seeing one of the animals. Only when trailed and treed by dogs are they to be seen readily. However, evidences of their presence and activity are relatively common. Their tracks are seen in summer along dusty trails or crossing roads, and rather commonly after the snows of winter come. The footprints are catlike, and measure from three to four inches in each surface dimension. The depredations of the Mountain Lion among the Deer are most evident during the winter. In that season the deer are concentrated in the foothills at the margin of the heavy snow, and then the Cougars have a relatively easy time to obtain prey.

Another "predatory" mammal, common in the high Sierras and likely to be seen by visitors to the park, is the **Mountain Coyote** (*Canis latrans lestes*). Standing about 20 inches high at the shoulder with a body length of 30 to 33 inches, with ears about 4 inches tall, and weighing as much as 25 pounds, some particularly long-haired and gray colored individual Coyotes are designated as "gray wolves" by local trappers. All efforts, however, to obtain actual specimens of the real wolf have been unavailing. The Mountain Coyote is less restricted in diet than the Cougar. It feeds upon a variety of small game such

as ground squirrels and gophers, and even at times captures insects; manzanita berries are also eaten in season. Coyotes sometimes feed upon deer, but their "venison" comes mostly from carcasses left by the Mountain Lion. The barking of the Coyote is often heard in the mountains and the combination of yelps, squeals, and howls in the voice of an individual often gives the impression that there are several rather than a single animal.

Bears there are in the Yosemite, even close about the floor of the Valley. Indeed, the word Yosemite, of Indian origin, means big bear or grizzly bear. If ever there were grizzlies in Yosemite Valley, as there were certainly at other points in the region such as Wawona, none are left to-day. The famous grizzly with its huge size, long front claws, and "silver-tipped" fur is extinct here now, but its smaller tree-climbing relative, the **Black Bear**, is still thriving in goodly numbers. These smaller bears exhibit two color phases, some individuals being black, others cinnamon; and litters of cubs have been seen in which one individual of the two was black and the other cinnamon colored. The name "brown bear" properly applies to a species not found here. The Black Bear is found throughout the Transition and Canadian zones of the park and is likely to be seen, from June until October, by visitors to the Yosemite Valley and adjacent points. The various garbage dumps which have been established in the Valley attract the bears regularly in the night time. Several bears have had their headquarters in the rock slides near El Capitan from where they can fare forth and hunt for food in the table and kitchen débris. Under native conditions they eat berries and seeds, beetles, ants, and other

insects, and small mammals; the wide variety of their likes in the matter of food places much material within easy reach. In October or early November the Bears seek some secluded cavern or hollow tree and curl up there for a sleep which lasts until early the following spring. Persons camping out in the mountains are sometimes disturbed by having their provisions raided by bears, but there are no instances known to us in which anyone has been injured by a bear when the start of the trouble did not lie with the person concerned.

There are numerous species of smaller carnivores in the Sierras of the Yosemite region. Many of these will be recognized at once as among the important "fur-bearing" species. About the rock slides of the Hudsonian Zone is the brownish colored **Sierra Pine Marten** (*Martes caurina sierræ*); in the forests of the Canadian and Hudsonian zones is found the **Pacific Fisher** (*Martes pennanti pacifica*), a much larger animal of generally similar build with a long bushy tail and much black in its pelage. In the highest parts of the mountains there is the **Sierra Nevada Wolverine** (*Gulo luscus luteus*), a heavy-bodied animal of yellow and brown coloration, now rare. About the buildings in Yosemite Valley and around rock slides in the higher mountains the **Mountain Weasel** (*Mustela arizonensis*) occurs in considerable numbers. The Weasel has a slender body, scarcely two inches through but nine or ten inches in length. The body color is yellowish brown in summer, but this changes to white in the winter season. The end of the long and slender tail remains black at all seasons so that in winter pelage our Weasel is an "ermine" in general appearance.

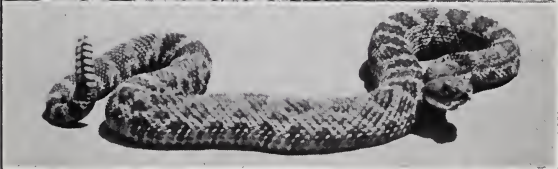


PLATE XIII

Three notable animals of Yosemite National Park
The California Grey Squirrel (upper), Tahoe Chipmunk
(middle), and Pacific Rattlesnake (lower)

Photos of squirrel and snake by J. T. Boysen, Yosemite; Chip-
munk by J. Dixon, California Museum of
Vertebrate Zoölogy

The predacious mammals considered thus far are all of considerable size, but there are "hunters" of smaller bulk though no less daring or active in their pursuit of prey.

The rocky shores of the streams and crevices beneath logs and brush constitute the forage ground of several small species of animals called **Shrews**. These are related to the moles, and may be known as a group by their long slender noses, long tails, and their short smooth fur. These small predators, most of which are less than two inches in length of body, are voracious feeders, to judge from their habits in captivity; their presence in a region suffices to explain why bodies of small birds or mammals disappear so quickly. When trapping in localities where Shrews abound it is not an uncommon experience to have specimens caught during the early hours of the night, half devoured by morning.

Bats are present in most of the region, whence at least eight species are now known. Certain species are restricted to the warmer valleys and foothills, others occur over the floor of the Yosemite gorge, and one species, the **High Sierra Bat**, has been taken at 10,350 feet altitude near Vogelsang Lake, almost the highest altitudinal record for any species of bat in this country.

Many of the larger accomplishments in nature such as the felling of large trees by storms, the scouring of valleys by freshets, or the results of earthquakes, are spectacular in the extreme; but other highly important operations are carried on in such an unobtrusive manner that they excite no popular interest or comment. The actions of **Gophers** and **Moles** and other burrowing animals as agents of erosion and soil manu-

facture are examples in this latter category. In cultivated districts the **Pocket Gophers** are looked upon as unmitigated nuisances, but their rôle in the mountains is totally different. The numerous earth mounds and tunnels made by Gophers play an important part in pulverizing and aerating the granitic soil and permitting water to permeate below the surface. The fine surface material is washed down by the melting snows and the summer rains to add to the fertile plains of the great valleys. During the summer the Gophers push the loosened soil from below ground out on the surface; but in winter this material is packed into tunnels in the snow and these "earth cores" are to be seen everywhere in the higher mountains in early summer.

Moles likewise live most of their time beneath the surface of the ground, but their structure, and habits, and their mode of life, are quite different from those of Gophers. The Moles never appear above the surface and their earth mounds are erupted from beneath, being split with many cracks and having a rough and irregular outline. The Gopher comes to the surface with each lot of earth he has loosened and pushes it out so that eventually his mound has a crescentic rim with a low spot at one side indicating the site of the exit after closure. Moles often run along just an inch or two beneath the surface of the ground and the resulting "ridges" are plainly evident in places where the animals have been hunting actively for insects. The Mole is chiefly if not wholly dependent upon insects, worms, and other low forms of animal life, while the Gopher feeds entirely upon roots and other parts of plants.

As stated in the opening paragraph there is a surprisingly large population of small mammals, the

presence of which can hardly be surmised by the casual observer. Intensive trapping shows that rock crevices, old logs, brush heaps, and the like are tenanted by large numbers of **White-footed Mice** of several species, all agile long-tailed rodents; the grassy meadows everywhere are the homes of chunkily built **Meadow Mice** with short legs and soft furry coats; and the higher meadows support many of the long-tailed long-legged **Jumping Mice**. In the rock slides of the higher mountains there lives the much larger **Bushy-tailed Wood Rat**. This animal, like its smooth-tailed house-building relative in the foothills, is commonly called "pack rat" or "trade rat" because of its habit of carrying away articles of camp equipment and often leaving in their places chips of wood, or other similar tokens. The Bushy-tail lives in the rock slides of the Hudsonian Zone, along with the Yosemite Cony and the Sierra Pine Marten. The Wood Rats exhibit some tendency toward house-building as is shown by the accumulations of twigs and sticks in some of the rock crevices, but the animals rarely do as much in this direction as the **Streator Wood Rats** in the Upper Sonoran and low Transition zones.

In the lodgepole pines of the Canadian Zone the work of the **Yellow-haired Porcupine** is to be seen in many places; more rarely the animal itself is discovered. The Porcupine scarcely needs description. It is a rodent, or gnawing mammal, of large size, weighing when adult fifteen pounds or more. The whole upper surface of the body is provided with long quills which grow out beyond the warmth-giving under-fur. These quills have very sharp points, provided with slight barbs which adhere readily to any rough or soft substance into which they are thrust, while the quills

are readily released from their attachment to the skin. The Porcupine cannot "shoot" its quills as is supposed by some persons, but for defense it curls its body up so as to be surrounded by its spiny covering and its tail is lashed from side to side. Any person or carnivore incautious enough to come in contact with the quills speedily receives a number of these in its flesh. The Porcupine has one particular item of forage which it seeks at all times of year, namely the inner growing layers of the bark of the pine. A recently-fallen tree is likely to have all of its branches stripped of bark and graven with the paired markings left by the incisor teeth of the animal. But downed trees are not a necessity, for the Porcupine climbs well and often its forage is obtained well up in some large tree. The lodgepole pine with its thin outer bark seems to afford the animal the most suitable kind of forage, and where common it is eaten to the exclusion of other coniferous trees.

This brief account of the more noteworthy mammals of the Yosemite section may well close with mention of that interesting resident of the large heaps of slide rock in the Hudsonian Zone, the **Yosemite Cony** (*Ochotona schisticeps muiri*), variously called "pika," "little chief hare" and "rock rabbit." The latter two names have reference to the relationship of the Cony with the rabbits, a kinship evinced more by internal structure than external features. The Cony measures less than seven inches in length and has no obvious tail, both pairs of legs are short, and the ears are rounded. The covering of hair everywhere is dense. Its habits are unique; it runs on all fours with a hobbling gait, and does not sit up on its haunches like a rabbit. Instead of migrating to a

milder climate, or else hibernating, during the winter season, the Cony keeps active even though its rock slide home is covered by many feet of snow. In summer it is busy with food-getting, and cuts, dries, and piles up in airy, yet protected places, large heaps of "hay." This includes stems and leaves from most of the common plants in the vicinity. The animals rarely forage beyond the margins of the rock slides, seeming to feel that within these heaps of tumbled granite they are afforded their only reliable protection. When not engaged in foraging the Cony is accustomed to perch on some one of its observation posts in the rock slide and there keep watch of the neighborhood. The nasal "bleating" notes are given at this time. Thus the Cony, unlike the rabbits, makes regular use of its voice.

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REPTILES AND AMPHIBIANS OF YOSEMITE NATIONAL PARK

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REPTILES AND AMPHIBIANS OF YOSEMITE NATIONAL PARK

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NEXT lower in the evolutionary scale below the birds and mammals stand the reptiles, including the turtles, lizards, and snakes, and next below them the group known as amphibians or batrachians comprising the salamanders, toads and frogs. The Yosemite region contains twenty-one species in the first named group and eleven in the second. Among all these "cold-blooded" vertebrates there is but one poisonous species, the Pacific Rattlesnake; none of the others need be feared at all. All the snakes, even the Rattler, will slip away quietly unless cornered and provoked into fighting. As normal parts of the protected animal life in Yosemite National Park no person should kill any of these reptiles or amphibians, save the Rattlesnake.

As a rule, the numbers of both species and individuals decrease with altitude. Above the Transition Zone there are but few reptiles, though amphibians are well represented as to individuals. One species in the latter group, the **Pacific Tree-toad** (*Hyla regilla*), may be heard in spring at almost all altitudes.

Although scarcely an inch in length, it is notably hardy and ranges up even to timberline. In the high mountain meadows will be found a toad peculiar to the region, the **Yosemite Toad** (*Bufo canorus*), and its mellow notes are pleasing additions to the chorus of bird songs just after the snow leaves. **Yellow-legged Frogs** throng all the stream sides and lake margins up to timberline. The salamanders are less in evidence, and careful search is required to locate them. One species, the **Lyell Salamander**, is known only from the Yosemite Park, the two known specimens having been taken in the head of Lyell Canyon at an altitude of 10,800 feet.

The **Pacific Mud Turtle** is the only representative of its tribe found in the region; it has not yet been discovered higher than the 3000-foot level in the western foothills. Of the nine kinds of lizards the most common and most widely distributed group comprises the "Swifts" (*Sceloporus*) which live about trees and on rocks and logs. These are dark bodied, with more or less blue on the under surface. The **Alligator Lizards** (*Gerrhonotus*) which have long slender bodies, small legs and large diamond-shaped heads are found in grass and under brush piles and chaparral. These are reputed to be poisonous, but their only defense when handled is to give their captor a sharp pinch in their relatively heavy jaws. They have no poison glands. In the leafy debris beneath the golden oaks along the walls of Yosemite Valley there is the large **Red-headed Skink** (*Plestiodon skiltonianum*) which has a pinkish-red head and olive-green body. It has exceedingly smooth scales so that it can slip through one's fingers as if oiled.

The snakes of the region comprise eleven species.

In the Yosemite Valley is found the **Rubber Snake** (*Charina bottæ*), a smooth scaled "double-ended" relative of the pythons and boas of the tropics but not known to exceed thirty inches in length. There are numerous **Garter Snakes** (*Thamnophis*) in the region. These are often called Water Snakes, in recognition of their preference for moist meadows and the margins of pools. They may usually be identified at once by the three light yellow stripes along the body, one on each side and the third along the middle of the back.

The most beautiful of the local snakes is the **Coral King Snake**, a small, smooth scaled, perfectly harmless species which lives along the golden-oak talus slopes and is frequently met with on the lower trails. Its banded coloration is of black, red, and yellow, all of bright tone. **Gopher Snakes** have been found in the western foothill country but have not yet been recorded within the park itself.

The **Pacific Rattlesnake** is likely to be found anywhere in the Yosemite National Park below about 8500 feet altitude, but in Yosemite Valley, and along the well-traveled trails so many of the snakes have been killed that the species is becoming rare in most of these places. The Rattler has many distinctive features, and in consequence will be recognized at once, even by persons who know it only by reputation. The head is bluntly triangular, the neck constricted; the stout body is covered with ridged or keeled scales, and the short tail has at the end a short segmented rattle which the animal can vibrate to produce the well-known warning sound. The Rattlesnake is essentially a ground dweller and seeks refuge at night and during the winter in a crevice in the rocks or a hole in the ground. Occasionally a number collect together in a

favourable location, forming one of the rattlesnake "dens" really more common in folklore than fact. The rattlers subsist largely upon small rodents—ground squirrels, chipmunks, meadow mice, and pocket gophers.

From time to time the Rattlesnake, like other snakes, sheds the outer layer of the skin, and each time this occurs a new segment is added to the rattle at the end of the tail; for the substance of the rattle grows in continuation with this outer "epidermis." These molts do not occur at any regular time, and some individuals probably molt much oftener than others so that the number of rattles cannot be taken as an index of the age of the snake, only of the number of molts it has undergone. The "button" at the end of the rattle and several of the terminal segments are sometimes lost through accident and so a very large snake may have only a few rattles. The largest number known to us to have been found in one series was twenty-two; eight to ten is near the average. At the time of molt the skin covering the eye is cast off and just previous to this operation the eye may be slightly clouded over. This has given rise to a belief that Rattlesnakes become "blind" (especially in late summer when many individuals molt), and it is currently believed that the snakes are then more likely to strike without rattling than at other times of the year.

When excited the Rattlesnake vibrates the tip of the tail rapidly, causing the horny rattle to give forth a cicada-like buzz that is unmistakable. If danger threatens, the snake places its body in a series of S-shaped curves, the tip of the tail being held vertically. To "strike," the reptile straightens out suddenly, lunging at its prey or enemy, dropping the

lower jaw and erecting the hollow teeth or "fangs" in the roof of the mouth so that they point almost straight forward. At best the Rattler cannot strike more than two-thirds its total length. Stories of snakes "jumping" at their enemies are without foundation. If the snake hits the object of its attack the two hollow fangs are buried in the flesh, the lower jaw is brought up and poison is forced into the wounds. Leather tramping boots or puttees usually afford full protection against the Rattlesnake, as the animals are not known to strike much if any over twelve inches above ground.

If a person chances to be struck by a Rattler certain things should be done, promptly but with as little flurry as possible.

(1) If bitten on the leg or arm, apply a tourniquet above the wound, that is, toward the heart from the bite. This is done in order to stop the flow of blood toward the heart. A bandana handkerchief twisted tight by means of a stick makes a good tourniquet.

(2) Cut the wound open with a pocket-knife, or cauterize with a red hot iron. If possible, inject a solution of potassium permanganate into the surface immediately surrounding the bite. If the solution cannot be made, apply crystals of permanganate directly at the place of the bite.

(3) After about one hour loosen the tourniquet slightly for a fraction of a minute, then tighten down again; after this, loosening and tightening should be done every fifteen minutes or so.

(4) The patient should be placed in a comfortable position. A mild stimulant, such as coffee, may be given. Do *not* give whiskey. A doctor should be summoned as soon as possible.

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FISHES OF YOSEMITE NATIONAL PARK

By

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THE FISHES OF YOSEMITE NATIONAL PARK

BY BARTON WARREN EVERMANN

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THE fish fauna of Yosemite National Park is not a rich one. Of native species there are two Suckers, three Minnows, and one Trout; and of these only the Trout is at all common. If we include the fishes not native to the region but which have been introduced into its lakes and streams, the number will be increased by nine additional species of Trout. The ten kinds of Trout in the park about in order of their relative abundance are:

Rainbow Trout; *Salmo irideus* Gibbons

Eastern Brook Trout; *Salvelinus fontinalis* (Mitchill)

Shasta Trout; *Salmo shasta* (Jordan)

Loch Leven Trout; *Salmo trutta levenensis* (Walker)

Cutthroat Trout; *Salmo clarkii* Richardson

Steelhead Trout; *Salmo gairdneri* Richardson

Brown Trout; *Salmo fario* Linnæus

Tahoe Trout; *Salmo henshawi* Gill & Jordan

Dolly Varden Trout; *Salvelinus parkei* (Suckley)

Golden Trout; *Salmo roosevelti* Evermann

This list includes most of the trout known from California waters.

The limited space available will permit only a very brief treatment of each species. It is hoped, however, that anyone interested can, with these short descrip-

tions, identify with reasonable certainty the fishes he may find within the limits of Yosemite National Park.

In the first place, let it be said that all *real* trout of whatever kind, belong to the Salmonidæ or Salmon Family. This family includes not only the true Trout but also the Salmons and the Charrs. Some of the species, usually the larger ones, are marine and anadromous, living most of their lives in the sea and coming into freshwater streams only for spawning purposes. Others live habitually and continuously in the colder streams and lakes.

Of all the families of fishes there is none more interesting than the Salmonidæ, from whatever point of view they may be considered. To the biologist, the family is of surpassing interest because of the remarkable life histories and habits of the many species; to the angler, no fish has appealed more strongly than the Salmon and Trout because of their game qualities and their beauty; to the epicure, there is none more delicious; to the lover of the beautiful as exhibited in animate forms, there is perhaps nothing that appeals more strongly than the silvery sheen, roseate or golden hues, and the beautiful form of the Salmon, the Brook Trout, or the Golden Trout; to the fish culturist, the Salmonidæ are of the greatest interest and importance, more species of this family being propagated artificially than of all other species combined; and to the commercial fisherman, this family of fishes is the most important in all the world.

The true Trout all belong to the genus *Salmo* and are found only in the northern parts of Asia, Europe, and North America; in Europe they extend as far south as the Pyrenees; and in America to Lower Cali-



PLATE XIV

Some Trout of Yosemite National Park

Top to bottom—Rainbow Trout, Steelhead Trout, Eastern
Brook Trout, Golden (or Roosevelt) Trout

Pictures from California Fish and Game Commission

fornia and Durango, and eastward as far as the Black Hills and Colorado.

California is richer in Trout than any other country in the world, the number of species or kinds now known from her lakes and streams being about a dozen.

It has been a more or less common practice to speak of the Trout of California as falling naturally into three series, popularly known as the Steelhead, Rainbow, and Cutthroat groups. This grouping is no longer accepted without reservations by ichthyologists. It has been shown that the Steelheads of California streams are simply Rainbows that have gone out to sea, and, after growing to considerable size and becoming silvery in color, have returned to fresh water, and that the Rainbows are simply the individuals that never went to sea. For present purposes, however, it seems best to treat them separately.

CUTTHROAT TROUT

Salmo clarkii Richardson

Other names.—Red-throated Trout; Clark Trout; Black-spotted Trout; Clark Cutthroat Trout.

Description.—The Cutthroat Trout can be readily known from all other trout by the red blotches on the membranes of the lower jaw. This mark is usually diagnostic of all the various species of so-called Cutthroat Trout, of which there are in western America not fewer than a dozen recognizable forms. These different forms may be distinguished from each other by proportional measurements, size of scales, and coloration. The Clark Trout is characterized by its

fine scales and the presence of small teeth on the hyoid bone.

Distribution.—This species occurs in streams and lakes from the Columbia River south to northwestern California. It probably did not occur originally anywhere in the southern High Sierra, but it has been introduced into many streams and lakes. In Yosemite National Park it is most abundant in the Tuolumne River from Hetch Hetchy to its source, in the South Fork of the Merced, and in Gaylor and Peeler lakes.

TAHOE TROUT

Salmo henshawi Gill & Jordan

Other names.—Henshaw Trout; Black-spotted Trout; Truckee Trout; Silver Trout; Redfish; Tommy; Black Trout; *Salmo tahoensis*; *Salmo purpuratus henshawi*; *Salmo mykiss henshawi*; *Salmo clarkii henshawi*.

Description.—Color, dark olive-green above, body everywhere with rather widely scattered black spots; red darker on membranes of lower jaw; body stout, the greatest depth about one-fourth the total length; scales small.

Distribution.—This is the common trout of Lake Tahoe and its connecting waters; also of Donner, Webber, and Independence lakes and the upper part of Truckee River. It is not common in the park, but was introduced into the Tuolumne River at Hetch Hetchy Valley, Soda Springs, and in the Lyell Canyon in 1896.

Habits.—During a portion of the year the Tahoe Trout lives in deep water, and can be caught, if at all, only on long lines. Early in the spring and in the

summer, they are to be found in relatively shallow water. It may be that food supply accounts for this migration, as spawning minnows seem to be the attractive food when the trout is in shallow water. The greatest number of this species are taken by trolling with a spoon. (Snyder.)

The Tahoe Trout appears to feed largely on minnows, but black ants and other insects are taken in quantity.

STEELHEAD

Salmo gairdneri Richardson

Other names.—Steelhead Trout; Steelhead Salmon; Salmon Trout; Hardhead.

Marks for field identification.—Large size; small head; large scales; bright silvery color; absence of red on lower jaw.

Distribution.—The Steelhead enters coastwise streams from Ventura northward, ascending to their headwaters for spawning purposes and then returning to the sea. Since 1917 the species has been introduced into Yosemite National Park in the Merced River and in Babcock, Emeric, Grant, Tenaya, and Ten lakes.

Habits.—The Steelhead is more or less anadromous in its habits, being migratory like the salmon and spending much of its time in salt water, and ascending freshwater streams at spawning time.

As a game-fish, the steelhead is a favorite with anglers. Its game qualities, together with its large size, make this one of the fishes most sought after by the followers of good old Isaak Walton. When in fresh water it will not only take the trolling spoon, but will rise readily to the fly.

The Steelhead is an excellent food-fish, and its large size and abundance make it of considerable commercial value. It is an important fish in the fish cultural operations of California and of other Pacific Coast states and of the Federal government. It has been introduced into Lake Superior and is now an abundant and much prized game-fish in that lake and its tributary streams.

The fact that most ichthyologists and many anglers regard Steelheads simply as sea-run individuals of Rainbow Trout has not escaped the writer's attention, and he himself is inclined to accept the view. Nevertheless it is known that in some places, they are entirely distinct and easily distinguishable. At any rate, it is deemed best for present purposes to treat the Steelhead as a distinct species.

RAINBOW TROUT

Salmo irideus Gibbons

Other names.—Mountain Trout; Speckled Trout; Brook Trout; California Trout. Sea-run form: Steelhead; Steelhead Trout; Steelhead Salmon; Salmon Trout; *Salmo rivularis*, in part; *Salmo gairdneri*, in part.

Description.—Body usually profusely covered with small roundish or star-shaped black spots, most numerous on back and upper part of side; middle of side with a rich rosy band; ground-color of back dark olive-green; fins all more or less spotted the dorsal, anal, and ventrals not usually tipped with white.

Distribution.—This is, as far as is known, the only native Trout in the Merced and Tuolumne rivers and their tributaries. It is very abundant in the park,

having been introduced or transplanted into most streams and lakes in the Yosemite region. Locally the species is confused with its close relative, the Shasta Trout, which has been widely planted in the waters of the park under the name of Rainbow Trout.

Habits.—As a game fish the Rainbow Trout is one of the best. It runs upstream in early spring to spawn, leaping over waterfalls and entering the small streams forming the headwaters. Here the eggs are deposited in the sand and the young hatched out.

By far the largest output of the state hatcheries is composed of Rainbow Trout, and there is a good reason, for this is considered the best game-fish of all, and it is most highly prized by anglers. The Rainbow often leaves the water in its eagerness to take a fly. So readily does it take a fly, in fact, that there is seldom need to resort to bait or other lures.

The Rainbow varies in coloring according to age, sex, and location. Those individuals which are able to reach the sea spend part of each year there, return to the freshwater stream a larger and more silvery-colored fish commonly called Steelhead. Spawning fish travel far up the coastal streams and spawn high up in the small tributaries. Their habits in this regard are more like those of the salmon than those of the trout. Unlike the salmon, however, the Steelhead does not, as a rule, die after spawning.

In beauty of color, gracefulness of form and movement, sprightliness when in the water, reckless dash with which it springs from the water to meet the descending fly ere it strikes the surface, and the mad and repeated leaps from the water when hooked, the Rainbow Trout must ever hold a very high rank.

The gamest fish we have ever seen was a sixteen-inch Rainbow taken on a fly in a small tributary of the Williamson River in southern Oregon. It was in a broad and deep pool of exceedingly cool water. As the angler from behind a clump of willows made the first cast, the trout bounded from the water and met the fly in the air a foot or more above the surface; missing it, he dropped upon the water only to turn about and strike viciously a second time at the fly just as it touched the surface; though he again missed the fly, the hook caught him in the jaw from the outside, and then began a fight which would delight the heart of any angler. His first effort was to reach the bottom of the pool, then, doubling upon the line, he made three jumps from the water in quick succession, clearing the surface in each instance from one to four feet, and every time doing his utmost to free himself from the hook by shaking his head vigorously as a dog shakes a rat. Then he would rush wildly about in the large pool, now attempting to go down the riffle below the pool, now trying the opposite direction, and often striving to hide under one or the other of the banks. It was easy to handle the fish when the dash was made up or down stream or for the opposite side, but when he turned about and made a rush for the protection of the overhanging bank upon which the angler stood, it was not easy to keep the line taut. Movements such as these were frequently repeated and two more leaps were made. But finally he was worn out after as honest a fight as trout ever made.

The Rainbow takes the fly so readily that there is no reason for resorting to grasshoppers, salmon eggs, or other bait. It is a fish whose gameness will satisfy the most exacting of expert anglers and whose readi-

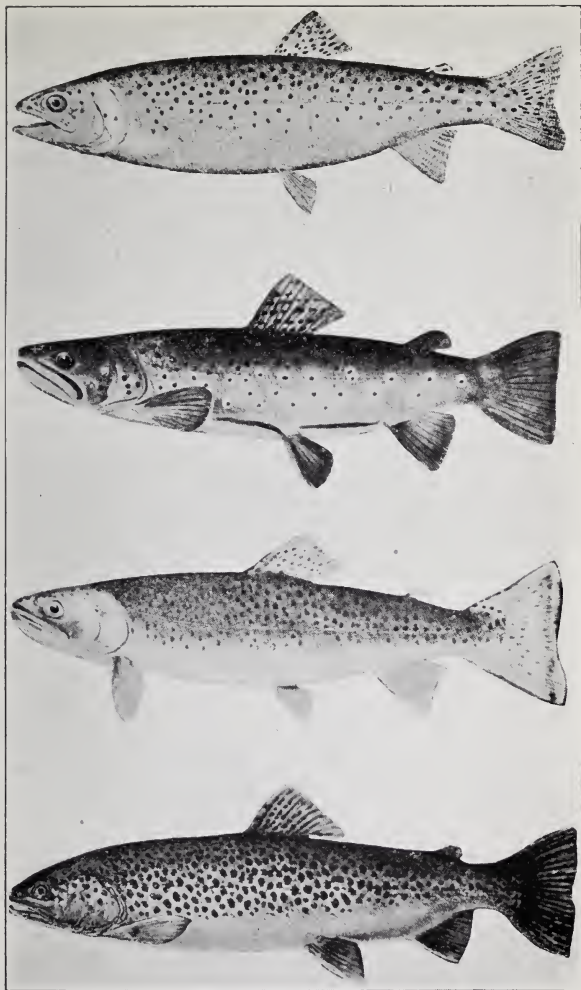


PLATE XV

Some Trout of Yosemite National Park

Top to bottom—Lake Tahoe Trout, Brown Trout, Cutthroat (or Black spotted) Trout, Loch Leven Trout

Pictures from California Fish and Game Commission

ness to take any proper lure will please the most impatient of amateurs.

Spawning takes place in winter and early spring, varying with the temperature and locality. The bulk of the eggs are usually taken in February, March, and April, although spawning continues through May in the mountain districts.

The Rainbow feeds on worms, insect larvæ, and salmon eggs. In streams in which the Salmon and Rainbow exist together, the Rainbow is more destructive to the salmon eggs than is any other species except the Dolly Varden.

SHASTA TROUT

Salmo shasta (Jordan)

Other names.—McCloud River Trout; McCloud River Rainbow; Shasta Rainbow; Rainbow Trout (of fish culturists); *Salmo gairdneri shasta*; *Salmo irideus shasta*.

Marks for field identification.—Differs from other Rainbow Trout, with the exception of that of the Klamath River, in its larger size, smaller mouth, and larger eyes; scales intermediate in size between Cutthroat and sea-run Rainbow, caudal fin more deeply incised than in typical Cutthroat.

Distribution.—McCloud River and streams of the Sierra Nevada from Mount Shasta southward at least to Calaveras County. This species has been widely introduced into the streams and lakes of Yosemite National Park where it is not officially distinguished from the true Rainbow.

Habits.—This Rainbow lives in water with a comparatively high temperature if it is plentiful and run-

ning with a strong current; but in sluggish water even when the temperature is considerably lower, no other species will do as well. This species appears to inhabit the rapids more largely than the slow-moving water. The spawning season in California extends from early February to May. Males are good breeders at two years of age, but the females rarely produce eggs until the third season. The Shasta Trout may lack a little of the wild gameness of the typical Rainbow, but that is made good by its larger size. It is largely an insect feeder and, therefore, a favorite of the fly fisherman.

This is the Rainbow which has been most widely used in fish cultural operations and has been more widely distributed than any other species.

THE GOLDEN TROUT OF THE SOUTHERN HIGH SIERRA

The Golden Trout of California are, so far as known, found only in the headwaters of the Kern River, all in the vicinity of Mount Whitney. Through the activities of the California Fish and Game Commission and other agencies, their original distribution has been somewhat extended by transplanting.

Four species of trout are now recognized as native to the upper Kern River Basin, namely: The Kern River Trout or Gilbert Trout (*Salmo gilberti*), the Soda Creek or White's Golden Trout (*Salmo whitei*), the South Fork of the Kern Golden Trout (*Salmo agua-bonita*), and the Roosevelt Trout or Golden Trout of Volcano Creek (*Salmo roosevelti*). All except the Gilbert Trout are of the Golden Trout type.

All four of these species belong to the Rainbow

series, the species of which as a whole may be distinguished, with greater or less difficulty, from those of the Steelhead series or sea-run Rainbows on the one hand by the usually brighter colors, and on the other hand from the Cutthroat series, by the absence of a red or scarlet dash on the throat, and the entire absence of hyoid teeth.

GOLDEN TROUT

Salmo roosevelti Evermann

Other names.—Roosevelt Trout; Golden Trout of Volcano Creek; Golden Trout of Golden Trout Creek; Volcano Creek Golden Trout; Mount Whitney Golden Trout.

Marks for field identification.—Color, delicate golden olive on the head, back, and upper part of the sides; clear golden yellow along and below the lateral line, overlaid by a delicate rosy lateral band; under parts rich cadmium yellow; body without black spots except on the caudal peduncle; scales extremely small.

Distribution.—The Golden or Roosevelt Trout is native only to Volcano Creek in the Mount Whitney region. It is a creek fish and appears to keep within the peculiar environment of this small stream. The species has been transplanted to and thrives in several near-by streams. In 1919 it was introduced into one of the unstocked lakes of Yosemite National Park.

Habits.—As a game-fish the Golden Trout is one of the best. It will rise to any kind of lure, including the artificial fly, at any time of day. In the morning and again in the evening, it will take the fly with a rush and make a good fight, jumping when permitted to do so; during the middle of the day it rises more

deliberately and may sometimes be tempted only with grasshoppers. It is a fish that does not give up soon but continues the fight. Its unusual breadth of fins and strength of caudal peduncle, together with the turbulent water in which it dwells, enable it to make a fight equaling that offered by many larger trout.

The scales are smaller than in any other known species of trout. They are so small, indeed, as to have caused so good an observer as Stewart Edward White to declare that this trout had no scales at all.

Although now abundant in Volcano Creek, the Golden Trout cannot long remain so unless afforded some protection. The great beauty of the Roosevelt Trout lies in the richness of its colors and in the trimness of its form—characteristics which fully entitle the species to be known above all others as *the* Golden Trout.

BROWN TROUT

Salmo fario Linnæus

Other names.—European Brown Trout; German Brown Trout; von Behr Trout.

Marks for field identification.—This Trout can be distinguished from all other species by the decidedly brown color of the back and sides, the black spots on the back, and red spots on the sides; the belly is silvery or brownish.

Distribution.—The Brown Trout was introduced into the United States in 1895, and since then a number of streams in California have been stocked. In Yosemite National Park it may be taken in the Merced River, in the south Fork of the Merced River, and in Merced and Edna lakes.

Habits.—The Brown Trout lives in clear, cold, rapid streams and at the mouths of streams tributary to lakes. It grows to be of large size, but matures at about eight inches in length. In its movements it is swift, and it leaps over obstructions like the salmon. It usually feeds in the morning and evening, is more active during evening and night, and often lies quietly in deep pools or in the shadow of overhanging bushes and trees for hours at a time during the day. Its food is formed of insects and their larvæ, worms, mollusks, and small fishes, and, like the Rainbow Trout, it is fond of the eggs of fishes. Spawning begins in October and continues until January. Eggs are deposited in crevices, between stones, under projecting roots of trees, and sometimes in nests excavated by the spawning fishes. The parents cover the eggs to some extent with gravel.

LOCH LEVEN TROUT

Salmo trutta levenensis (Walker)

Other names.—Scotch Trout; *Salmo levenensis*.

Marks for field identification.—The true Loch Leven Trout is a slimmer fish than the Brown Trout, and the adipose fin is smaller. Furthermore, it is fully spotted and lacks the brown color of the Brown Trout. The sides are silvery, with a varying number of X-shaped black spots or rounded brown or black spots.

Distribution.—This trout, a native of the lakes of Scotland, was introduced into California in 1894, and has since been placed in many streams and lakes of the State. Seventeen lakes of Yosemite National Park—among them the noted Benson, May, Merced,

Washburn, and Ten lakes—have been stocked with this species. Fry have also been planted in the Merced and Tuolumne rivers.

Habits.—The spawning season may begin in October and continues until January. This trout is largely non-migratory in its native habitat. It takes the artificial fly readily. The food of this species includes freshwater mollusks, crustaceans, worms, and small fish. Hybridization between this species and the Brown Trout is common.

EASTERN BROOK TROUT

Salvelinus fontinalis (Mitchill)

Other names.—Brook Trout; Speckled Trout; Fontinalis; *Salmo fontinalis*; American Charr.

Marks for field identification.—This beautiful and best-known trout is easily distinguished from all other trout of our waters by the red spots on the sides but not on the back, and the mottled or marbled color of the upper parts.

Distribution.—This trout is native only to the eastern part of North America westward to Minnesota and Iowa. It has been introduced very widely all over the world. It has been placed in many California streams and lakes and is one of the most abundant species in most streams and lakes of Yosemite National Park.

Habits.—Eastern Brook Trout abound chiefly in cold, slow-running meadow brooks; but they thrive in all pure cold waters whether of stream, lake, or pond. The fish is wary and great skill is required to catch it. The outstanding peculiarity of its habits is evidenced by the fact that a person acquainted with

its haunts can go out and catch a string of Eastern Brook in a comparatively short time, while others, with better tackle and equal skill, will fish a whole day for them in vain. The largest Brook Trout are found in the deep, wide pools in the warmer rivulets near their source. Eastern Brook Trout do not keep well nor ship well, probably on account of the fat. They spawn high up in tributary streams and so early (October to January) that eggs for hatchery purposes are almost impossible to obtain.

DOLLY VARDEN TROUT

Salvelinus parkei (Suckley)

Other names.—Malma; Salmon Trout (Alaska and Montana); Bull Trout (Idaho); Western Charr; Oregon Charr; *Salvelinus malma* (in part).

Marks for field identification.—This fish may be readily distinguished from all other species of Salmonidæ native to western America by the presence of small red or orange spots on the body. From the Eastern Brook Trout (introduced into many California waters) which also has red spots on the body, the Dolly Varden Trout may be known by the absence of blackish marblings or reticulations on the back, and by the presence of red spots on the back.

Distribution.—The Dolly Varden Trout is of wide distribution. It is found from western Montana and Idaho to Oregon and Washington, and northward through British Columbia and Alaska to the Arctic. In California it is native only to the McCloud River, but has been introduced into other streams. In Yosemite National Park the species is found only in one of the Chain o' Lakes at the source of the South

Fork of the Merced River and very rarely in the Merced River in Yosemite Valley.

Habits.—The Dolly Varden is the poorest of all trouts. It does not rank high as a game-fish, and, as a food-fish, it is inferior to any other species. In Alaska it is very destructive to the eggs and fry of the salmon. It attains a weight of two to twelve pounds.

This completes the list of Trout, both native and introduced, that are found in Yosemite National Park. There remain but two suckers and three minnows that might be found within the park limits. The Sacramento or Western Sucker (*Catostomus occidentalis*) is common in the lower reaches of all streams of the State, but the Hardhead Sucker (*Pantosteus aræopus*) is a very rare species. Of the three species of Minnows, the first is the Kaweah Chub, Lake Fish, or Hardhead (*Mylopharodon conocephalus*), one of the largest of Minnows. It reaches a length of two or three feet and a weight of several pounds. The next Minnow is the Sacramento Pike or Squawfish (*Ptychocheilus grandis*). This fish, which reaches a length of two or three feet, is abundant in the lower portions of all the larger tributaries of the San Joaquin. Still another minnow is the Chub (*Siphateles formosus*), a small species, usually not exceeding four or five inches in length. So far as the writer knows none of these minnows or suckers has been recorded from any locality within the limits of Yosemite National Park.

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OF
YOSEMITE
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To the uninitiated the word "insect" conjurs all kinds of creepy crawly "bugs"—yet to those who are at all interested in Nature, the study of entomology is a most fascinating one. The insect fauna of Yosemite National Park is especially rich and offers an excellent field to collectors. Indeed, so numerous are the species that many will be noticed by even the most casual observer. The Nature-lover will be most attracted by the multi-colored butterflies, the day-flying moths, the bronze and gold timber beetles, and such other insects as are beautiful in form and have interesting habits. To the naturalist all of the insect life will be attractive and he will be kept busy, for the region possesses a most wonderful assemblage of forms. Even the most prosaic individual must needs take notice, for the thirsty mosquito or deer fly will sooner or later tax him for a meal and the sociable ant will always be ready to welcome him.

The butterflies and moths, which belong to the order *Lepidoptera*, are generally the first to claim attention. Some of the former will be seen in the park no matter where one wanders. In the meadows there will be the ever present sulphur butterfly (*Colias*

eurytheme Boisd.) and numerous busy **skippers**, as well as an occasional large orange-red **fritellary** or **silver spot**, so named from the numerous silvery patches on the under side of the wings. The largest of our mountain fritellaries is **leto** (*Argynnis leto* Behr. Plate xvi, 9), a noble insect with a wing expanse of about three inches, but the commonest is **Behr's fritellary** (*Argynnis monticola* Behr.), a somewhat smaller species. About damp patches along the roadside or at the sandy margins of streams great congregations of butterflies may often be seen, all eagerly quenching their thirst. The dominant species here will generally be the **California tortoise shell** (*Vanessa californica* Behr.) which is of a rich red color above and dark, almost black, beneath. This insect is always abundant in the mountains. Some years its larvæ have been so numerous that they have become serious pests, defoliating the deer brush and other species of wild lilac over extensive areas. Other butterflies often found drinking are numerous species of **blues** and a sprinkling of **white admirals** (*Basilarchia lorquini* Boisd.). The latter is a moderate-sized, black butterfly with red tips to the wings. A somewhat larger butterfly which simulates it in color pattern is *Adelpha bredowii* var. **californica** But. (Plate xvi, 4). Of the several swallowtails the commonest is the dark yellow **tiger swallowtail** (*Papilio rutulus* Boisd.). Less common is its creamy colored cousin, *Papilio eurymedon* Boisd., and the prize of all is the **two-tailed swallowtail** (*Papilio daunus* Boisd. Plate xvi, 1) which is a rare visitor.

As one leaves the Valley and enters the high country other butterflies will be noticed. One of these, *Parnassius clodius* Menetr. (Plate xvi, 11), is truly a

butterfly of the high mountains. It is of fair size, white, with several short black bars on the forewings and a few pink spots on the hind, and with much of the wing membrane uncovered by scales. One most often sees it flying about the higher mountain meadows or beneath such scattered trees as occur in the alpine forests. One may at times notice flying about the yellow pines numbers of the **pine white** (*Neophasia menapia* Feld. Plate xvi, 8). Its distinguishing characteristic is the pinkish outlining to the veins on the underside of the wings. The caterpillars of this species often greatly injure the pines through defoliation. At the tops of the various domes and at other exposed lookout places two more **whites** (*Pieris sisymbri* Boisd. and *Pieris occidentalis* Reak.) may generally be seen on sunny days. These prominent places are, in fact, favorite congregating spots for many types of insects besides the butterflies. Lazily sailing across the valleys we are almost sure to see our well-known friend from the lowlands, the **monarch** or **milkweed butterfly** (*Anosia plexippus* Linn.). This large red butterfly wanders far and wide during the summer months in search of the food plant for its young, the various species of milkweed, but in late autumn it migrates to the coast to one or the other of its numerous assembling grounds where it spends the winter. The highly prized black **alpine swallowtail** (*Papilio indra* Reakirt. Plate xvi, 6) may also greet one's vision as it soars away from its rocky heights.

Mountaineers will probably be familiar with our three most common high-mountain species. The brilliant little **copper** (*Chrysophanus cupreus* Edw. Plate xvi, 3) may often be seen basking in sunny spots in Tuolumne Meadows. **Behr's sulphur** (*Colais*

behri Edw. Plate xvi, 5), a rather small greenish yellow butterfly, which haunts the most alpine meadows and grassy slopes, is a southern remnant or relict of an arctic race left stranded and isolated in our southern Sierra. That hardy gray satyr of the heights, *Æneis ivallda* Mead. (Plate xvi, 7), can only be found about the crags and high rocky slopes where it flies freely from place to place when the weather is pleasant but instantly settles when it is otherwise, and because of the harmony of its colors with the surroundings disappears from view. Even this habit does not always protect it, for many a specimen has been caught up by a mountain storm and left to perish high up on the snowfields and glaciers.

Of the moths there are even more species to be found than there are of the butterflies, but the most are of somber appearance or so small that they will rarely attract the notice of any but the expert. Of the more conspicuous several are day-flying like the showy orange and black "**sheep moth**" (*Pseudohazis eglanterina* Boisd. Plate xvi, 10). This flies throughout the chaparral areas of the Sierra and as a result may often be seen about the lower ridges and lesser peaks. Its larvæ when fully grown are several inches long and black, armed with prickly yellow spines. They feed on the willow and several of the chaparral shrubs. Another day-flying moth is the **wild forget-me-not moth** (*Gnophæla latipennis* Boisd. Plate xvi, 2), a beautiful black species maculated with yellow. Whenever one can locate a patch of its food plant at higher levels it can generally be found. The most conspicuous of the night-flying moths is the large **California silk moth** (*Samia rubra* Behr.), a moth with a wing expanse of several inches and with a brick



PLATE XVI

Some Butterflies and Moths of Yosemite National
Park

red color. This species in its earlier stage feeds on various shrubs, chiefly the pigeon berry or cascara, and as an adult may often be attracted to light. The most important moth in the park, however, from the standpoint of destructiveness is a very diminutive one. It is the **lodgepole pine** or "tamarack" **needle miner** (*Recurvaria milleri* Busck.), so called from the fact that its larvæ tunnel the terminals of the needles of this common pine of the higher altitudes. This kills the needles, thus weakening the trees so that they fall an easy prey to the attacks of the destructive bark beetles. The great areas of dead "tamaracks" or lodgepole pines which one sees in the mid-Sierran region bear mute testimony to the destructiveness of this insect.

After the moths and butterflies, the beetles or *Coleoptera* provide us with the greatest number of showy representatives. Among the conspicuous species of this order in the park are a number of the long-horned wood boring beetles of the family *Cerambycidae*. One of these, the **elderberry beetle** (*Desmocerus auripennis* Chev. Plate xvii, 4), is often to be seen resting on the leaves of its food plant. It is a large bluish-black beetle with wing cases entirely red if a male or blue bordered with red if a female. Another is the **maculated timberman** (*Monohammus maculosus* Lec. Plate xvii, 7), a large black and white clouded beetle which may often be found resting on the sticks of corded pine wood or stretched out along the protected portion of an old log. When isolated from its environment this is a very conspicuous insect, but when at rest on the side of an old log, it so thoroughly blends with its surroundings that it is hard to detect. A most interesting and peculiar long-horned beetle is

Ulochætes leoninus Lec. (Plate xvii, 8), a good-sized and somewhat hairy black and yellow barred beetle which has its wing cases so very much abbreviated that the greater portion of the wings are exposed to view even when folded. This species haunts the dead yellow and Jeffrey pines. On milkweed plants another very conspicuous member of the family may be seen. It is the so-called **milkweed beetle** (*Tetraopes femoratus* var. *basalis* Lec.) which is of a bright red color spotted with black. Many of the beetles of this family are pollen feeders, and such flowers as the wild lilac and wild hellebore are especially attractive to them. Here many of the wasplike members of the great genus *Leptura* (Plate xvii, 18) may be found. Even at night one may collect some of these beetles for many are nocturnal and often fly to lights. Two of the largest are *Ergates spiculatus* Lec. (Plate xvii, 17) and *Prionus Californicus* Mots. (Plate xvii, 15), the former over two inches in length and the latter an inch and a half and both of a reddish-brown color.

Another group of timber beetles are the so-called **jewel beetles**, the family *Buprestidæ*. Within the park a good collector might find twenty species. The best known is the **golden-lined Buprestid** (*Buprestis aurulenta* Linn. Plate xvii, 6), a beautiful greenish or bronze-green beetle margined with gold. This species, which is about one inch in length, breeds in both pines and firs. Another species is *Buprestis fasciata* Fab., the male of which is green blotched with yellow and the female entirely green. These generally rest on green willow or poplar leaves, but during their young lives live in the Douglas fir. Two of the smaller members of this family sometimes do considerable damage through the work of their larvæ.

The first of these (*Melanophila drummondi* Kirby) is a flat bronze beetle generally spotted with yellow which normally breeds in the dead Douglas and true firs. The other (*Melanophila gentilis* Lec.) is a rich blue-green or greenish-blue species which is restricted to the pines. Most of the members of this family confine themselves to their food trees, but a few frequent flowers.

A third group of timber beetles are the so-called bark borers or engraver beetles of the family *Scolytidæ*. The members of this family are generally small and of somber color, but they are at times very abundant and often tremendously destructive. The females bore tunnels beneath the bark where they deposit their eggs. The young, upon hatching, also bore tunnels, but generally in the opposite direction. As a result of the work of adult and larvæ the tree is soon girdled. Though these beetles normally attack only the dead and dying trees, they at times turn their attention to the living ones. As a result there is an enormous loss of some of our very best timber every year. In the park itself one may notice many trees which are gradually dying as indicated by the yellowing of their tops, or trees with brown needles which are already dead. If one strips off the bark of any of these trees he will find the insects at work or if they have emerged he will find the results of their labors, the peculiar adult and larval tunnels which generally engrave both bark and sapwood.

Among the host of other beetles which are to be found on the herbage, on the ground, or in the water, but a few can here be mentioned. One of these is the true **milkweed beetle** (*Chrysochus cobaltinus* Lec. Plate xvii, 20), a chunky beetle of brilliant metallic

blue color. It feeds upon the roots of the milkweed during the larval stage and on the foliage as an adult. In spite of its conspicuousness it is rarely molested by birds, no doubt because like the lady beetles it is very distasteful to them. Another interesting night-flying beetle is the large white striped **June beetle** (*Polyphylla decemlineata* Say. Plate xvii, 19), which is perhaps the largest of its family in the mountains. It often comes tumbling about one's house or camp fire. A smaller and somewhat distant relative of the latter is the little "**tumble bug**" (*Canthon simplex* var. *militaris* Horn). This bluish-black beetle with red shoulders is a close relative of the sacred scarabeus of Egypt and has similar habits. If one watches the less frequented roads and trails he may be rewarded by finding some of these beetles at work hauling and pulling their precious pellets to a safe retreat. In the flower of the azalia another species of scarabid may be found. This is a very pretty pollen- and petal-feeding species (*Hoplia dispar* Lec.) which may appear in a dress of various colors—orange, brown, or green.

Among the ground beetles most species are of somber appearance, but there are a few exceptions. Two of these are the brilliant green **tiger beetles** (*Cicindela perveridis* Schaupp. Plate xvii, 1, and *Cicindela depressula* Casey). These are generally to be found only at the higher altitudes and generally on the grassy slopes just below the snow fields. Here their larvæ sink their shafts into the earth and lie in wait for their prey while the active and long-legged adults seek theirs in the open chase.

In the water there are also many beetles both great and small. Some, like the **water scavengers** (*Hydro-*

philidæ), prefer warm and stagnant waters; others, like the **whirligigs** (*Gyrinidæ*), most enjoy skating over the surface of the water; and still others, like the predaceous **diving beetles** (*Dytiscidæ*), will live and thrive in even the coldest streams and lakes. The most interesting aquatic beetle in the mountains is *Ampizoa insolens* Lec. (Plate xvii, 3). It is a flattened beetle a little less than a half inch in length and in color an opaque black. It may be found crawling over the rocks and in the cold mountain streams. Although it lives in the water it looks more like a land dweller and is, in fact, equally related to both land and water beetles. It may be well to state that not one beetle in our country is poisonous, and that all may be handled with perfect safety. A very interesting beetle collection may easily be made by carrying a small vial of alcohol. Specimens should be removed and mounted on pins at the end of each day's collecting.

There are in the park a goodly number of species of wasps, bees, ants, and other insects of the great order *Hymenoptera*. Most of these are small, but a few such as the **horn tails** or **wood wasps** are of fair size. The females of these insects are provided each with a long, stout drill which enables them to bore straight into solid wood where they deposit their eggs. One of these, a large black species with orange wings (*Urocerus Californicus* Nort. Plate xvii, 2), has an appearance not unlike some of the large so-called tarantula hawks of the Southwest. It is harmless, however, for it cannot sting. The larvæ often do considerable damage to timber and would do even more were it not for the fact that they are heavily parasitized by a large wasp of the family *Ichneumonidæ*.

One of these is a black and yellow insect (*Megarissa nortoni* Cress. Plate xvii, 5) which has a threadlike ovipositor longer than its body—so long, in fact, that it cannot be used in the usual way but must be curled over the back and brought down in front of the head before it can be used. With this wonderful instrument a hole is soon sunk in the timber where the wood wasp larvæ are boring, and an egg is laid in their neighborhood.

Among the larger bees the **carpenter bees** of the genus *Xylocopa* are perhaps as notable as any. These black or bluish-black bees are fully as large as bumble bees and every bit as energetic. They have a habit of selecting well-seasoned wood such as an old cedar fence post or a portion of a building, and of excavating out a long chamber for their young much in the same way that a woodpecker does. If one approaches their home they circle about in a threatening manner but rarely do they attack one.

Other wood workers of this order which might be mentioned are the large **timber ants** of the genus *Camponotus*. These are either black or red and black, and are the largest ants we have. Their nests are made in old logs and stumps and even in the hearts of growing trees when they have the opportunity to enter through an old scar. At times they do some damage but on the whole they are beneficial, for the workers destroy great numbers of destructive forest beetles; furthermore their wood work is, as a rule, only in old logs which are useless and should be removed. The winged adults of these ants often congregate in great numbers, like the lady beetles, about the summits of the lesser peaks.

Of the two-winged flies or *Diptera* there are also a

great number, some of recognizable size and of peculiar interest. About the meadows and in the neighborhood of watercourses **mosquitoes** are often quite abundant. At higher altitudes, however, there is nothing to fear from these insects other than the annoyance of a few bites, for there are no malaria carriers or *Anopheles* much above five thousand feet. A small vial of oil of citronella will generally provide the means of repelling the meadow species. **Horse flies** and **deer flies** (*Tabanidæ*) are also annoying at times, but the selection of proper camp sites away from marshy places, their normal breeding grounds, will generally give ample protection. Among the flies that will catch one's eye during his rambles are the **sun** and **hover flies** (*Syrphidæ*. Plate xvii, 12 and 14), many members of which, in their early stages, prey upon plant lice and which, in the adult stage, often mimic bees and wasps with which they often associate. One will also see many **bee flies** (*Bombylidæ*. Plate xvii, 9 and 11), some hovering about the flowers like humming birds and others skimming over the ground to alight here and there in sunny spots. Often the **robber flies** (*Asilidæ*. Plate xvii, 16) may be noticed. These hawks of the fly world are parasitic in their larval state and predaceous in the adult stage. The more gayly colored species haunt the forests where they may be seen sunning themselves on old logs, but the more somber colored, the grays and browns, frequent sandy areas.

Among the other orders of insects the **grasshoppers** will, of course, claim a certain degree of attention. Of these we have a few meadow species which, like the **devastating grasshopper** (*Melanoplus devastator* Scudd.), may at times destroy much of the upland

feed but are generally not numerous enough to greatly exceed their demand as fish bait. Many species, however, are quite interesting to those who will take time to observe them. Some of these have beautiful underwings of yellow, orange, red, blue, or black and some clap their wings together in flight and hover hawk-like as they rise, giving out such a strident sound that they can be heard for some distance. One of the latter, a blue-winged species (*Cireottix thalassinus* Saus.), is more common farther north, but a second, a black-winged species (*Cireottix maculatus* Scudd.), is fairly abundant at high altitudes in the middle Sierra. Many of the grasshoppers also show marked degrees of color protection, an example being the white and black species which chooses only granite slopes for a resting place.

Nests of **termites** or **white ants** may often be found in the woods beneath the bark of old fallen trees. We have but few species of these insects outside of the tropics, but one of our species is exceedingly large. This is a brown species (*Termopsis nevadensis* Hagen. Plate xvii, 13) which is found widely distributed throughout California but which is especially abundant in the mountains. The insects are very industrious creatures and will in a short time completely honeycomb a large log. Upon opening one of these nests one finds not only a host of their light colored workers and big-headed soldiers but also many winged adults. Many hours might be spent interestingly and profitably investigating the habits of these remarkable social insects. Even the bears are fond of the termites and the Indians likewise dig out their nests and use the eggs and larvæ for food.

In the water one may find the interesting **caddice**

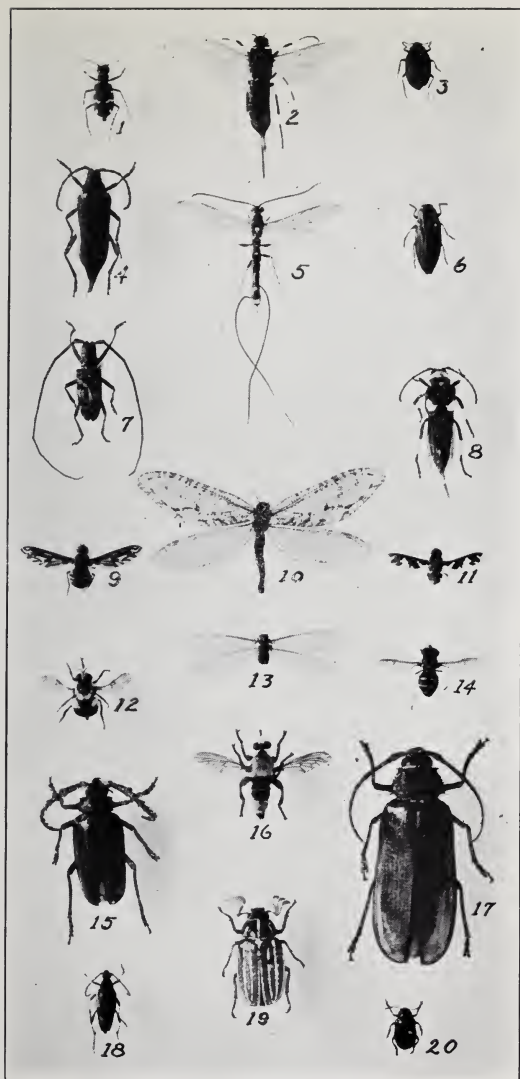


PLATE XVII

Some Beetles, Wasps, and Flies of Yosemite
National Park

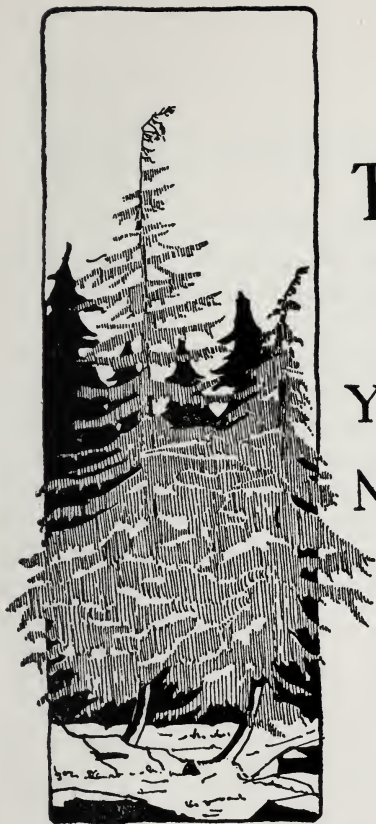
fly larvæ, each enclosed in its own peculiar case, and also the flat bodied larvæ of the **rock flies** crouching close against the rocks. The adults of both insects will be found in the immediate neighborhood, the moth-like caddice flies dancing over the waters and the rock flies resting along the banks. A somewhat distant relative of the above flies is the night-flying brown **lace-winged fly** (*Polystoechotes punctulatus* Fab. Plate xvii, 10). It is the largest of its race and peculiar in that its larvæ have never been discovered.

In this short article it is possible to mention briefly only a few representative species of the different types of insects found in Yosemite National Park. The following list of references will aid those who wish to investigate more thoroughly the fascinating science of Entomology.

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TREES
OF
YOSEMITE
NATIONAL
PARK

By

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TREES OF YOSEMITE NATIONAL PARK

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THE forests of the West, although the grandest in the world, are not at all complex, for where one might find two hundred and fifty varieties of trees in some of the eastern hardwood forests, he would find but thirty-five species within the 1125 square miles of Yosemite National Park. Of these few species the conifers (cone-bearing trees) are by far the most important. They may easily be identified by the aid of the *Key to the Trees* in the appendix of this volume.

In the Sierra Nevada Mountains the abrupt rise from almost sea level to twelve or thirteen thousand feet causes within a few miles as great a diversity of climates as one would encounter in traveling from Mexico to Alaska. Each tree species has its own climatic requirements. We therefore find the trees occurring in definite belts, one above the other. Those hardy pioneers which can withstand the long and intense cold of arctic winters have been driven to timberline, while the most drought-resistant species have claimed the dry foothill regions. So definite is this balance in Nature that, by observing the trees,

one can estimate quite definitely the altitude at which he stands.

Entering the park from the west, one first passes through the treeless or oak-dotted San Joaquin Valley and lower foothills. In the upper foothills and lower mountains (1000 to 3000 feet altitude) is the **Foothill Forest** (Upper Sonoran Zone). Only a few species can withstand the severe drought of the long arid summers and these grow in open park-like stands. The one characteristic conifer of the region is the silvery gray, many-branched **digger pine** (*Pinus sabiniana*). The small **knobcone pine** (*Pinus attenuata*) occurs but infrequently. Of the hardwoods, the oaks are predominant. Among these are the **valley oak** (*Quercus lobata*), the **California black oak** (*Q. californica*), the **interior live oak** (*Q. wislizeni*), and the **canyon live oak** (*Q. chrysolepis*). Along the streams may be found several species of **willow** (*Salix* sp.), **black cottonwood** (*Populus trichocarpa*), **California buckeye** (*Æsculus californica*), **mountain laurel** (*Umbellularia californica*), and **California nutmeg** (*Tumion californicum*). The brush or chaparral which covers many of the hillsides is often interspersed with scattered specimens of **mountain mahogany** (*Cercocarpis parvifolius*).

At about three thousand feet elevation one enters the **Main Timber Belt** (Transition Zone) of the Sierra Nevada. This forest, which extends from three thousand to seven thousand feet altitude, is one of the finest in the world both as regards size and value of timber and perfection of its charming landscapes. At the lower elevations the first trees to greet one are the brilliantly green **western yellow pine** (*Pinus ponderosa*), the fragrant **incense cedar** (*Libocedrus decurrens*), and



PLATE XVIII

A Yosemite forest of Pine, Fir, Incense Cedar, and Sequoia

Photo by A. C. Pillsbury

the rugged **Douglas fir** (*Pseudotsuga taxifolia*). At an altitude of about five thousand feet we find the giant **sugar pine** (*Pinus lambertiana*) and the beautiful **white fir** (*Abies concolor*) forming an important part of the forest family. Here and there are groves of the monarch of all trees, the **giant sequoia** (*Sequoia gigantea*). At higher elevations the **Jeffrey pine** (*Pinus jeffreyi*) replaces its close relative the western yellow pine. In the lower part of the Main Timber Belt and generally on the fertile bottomlands are a few hardwoods. Most beautiful of all these is the **flowering dogwood** (*Cornus nuttallii*). Others are the **broadleaf maple** (*Acer macrophyllum*), its close relative, the **dwarf maple** (*Acer glabrum*), the **black cottonwood** (*Populus trichocarpa*), the **quaking aspen** (*Populus tremuloides*), **California black oak** (*Quercus californica*), **canyon live oak** (*Quercus chrysolepis*), **California laurel** (*Umbellularia californica*), **alder** (*Alnus rhombifolia*), and various species of **willow** (*Salix* sp.).

Above the Main Timber Belt between the altitudes of seven thousand and nine thousand feet is the **Sub-alpine Forest** (Canadian Zone), a region characterized by dense forests of small or medium-size trees. The typical trees of the region are the **red fir** (*Abies magnifica*), **white fir** (*Abies concolor*), **lodgepole pine** or "tamarack" (*Pinus contorta*), and **Jeffrey pine** (*Pinus jeffreyi*). On open rocky sites the **western juniper** (*Juniperus occidentalis*) is conspicuous, and near the upper limit of the belt the **western white pine** (*Pinus monticola*) occurs scattered throughout the forest. The only hardwood of the region is the **quaking aspen** (*Populus tremuloides*) which forms beautiful groves in some of the high mountain garden-spots.

In the **Alpine** or **Timberline Forest** (Hudsonian Zone),

which extends from approximately nine thousand feet elevation to timberline, only the hardiest species can exist. The two principal trees are the graceful **mountain hemlock** (*Tsuga mertensiana*) and the storm-resistant **white bark pine** (*Pinus albicaulis*). At the lower edge of the belt these merge with **red fir** (*Abies magnifica*), **western white pine** (*Pinus monticola*), and **lodgepole pine** (*Pinus contorta*).

Yosemite Valley might be called the meeting place of the trees. Although at an altitude of but four thousand feet, several species which are normally found at twice that elevation thrive in the shade of the great south wall. The opposite side of the Valley is so warm that we find many patches of vegetation typical of the foothill region. For the tree-lover and botanist the Valley is therefore an ideal vacation land, both because of the great variety of plant life within its walls and the accessibility to the high country beyond.

So much for the trees as they live together in communities—but let us now seek to know them as individuals. Botanists have grouped all plants according to their relationship into divisions, classes, orders, families, genera, and finally species. Since some trees have as many as twenty different names, each of which is used exclusively in a different locality, it is important to state also the botanical (or universal) name. This is a combination of the names of the genus and species to which the plant belongs.

Everyone is familiar with the two broad classes of trees—the broadleaf trees or hardwoods, and the evergreen trees or conifers. The former group, although abundantly represented in Yosemite Valley,



PLATE XIX

Red Fir—White Fir forest on the Pohono Trail which passes
through miles of most exquisite wild flower gardens

Photo by Ansel F. Hall

probably forms less than one per cent. of the forests of the park. The conifers will therefore be described more in detail.

Cone-bearing trees are classified by dendrologists into three families: the **Pine Family** (*Pinaceæ*), the **Redwood Family** (*Taxodiaceæ*), and the **Cypress Family** (*Cupressaceæ*). Their leaves are retained from two to ten years, which causes them to be called evergreens.

The **Pine Family** is by far the most important in the park—for that matter, in all the world. It contains all the pines, firs, hemlocks, and the Douglas fir and also the spruces, larches, and true cedars. The latter do not occur in the Sierra. All these trees have needle-like leaves and bear but two seeds beneath each scale of their cones.

The **pin**es (Genus *Pinus*) are represented in the park by eight species, some of which may be found at any altitude. The characteristic distinguishing this from all other genera is the occurrence of the needles in bundles of five, four, three, or two (and in one species singly), the base of each bundle being surrounded by a paper-like sheath. The five-needle pines are called the **white pines** and those with three needles the **yellow pines**.

Of the three five-needle pines of the Park, the **sugar pine** (*Pinus lambertiana*) is by far the most important. It is not only the largest pine in the world but also one of the most majestically beautiful. It may easily be recognized (a) by its carmine-brown flaky bark which is generally divided into long plates by longitudinal fissures, (b) by its five-needle bundles about three inches in length, and (c) by the immense cones (twelve to twenty-four inches long) which hang pend-

ent from the tips of the long straight horizontal branches, or which may be found on the forest floor beneath. A white sugar which exudes from the heartwood when the tree is wounded gives it its common name. On the floor of the Valley are but few specimens, but a short distance up the slopes the species enters into the forest composition and grows abundantly up to about seven thousand feet elevation.

The **western white pine** (*Pinus monticola*) which forms an important part of the forests of Idaho and Montana, occurs in California—the southern part of its range—only on the higher mountain slopes, ranging in the park from 6500 to 10,000 feet elevation. The young trees with their bluish-green foliage and silvery gray bark are exceedingly symmetrical. Trees over two feet in diameter take on a more rugged appearance and their bark, which then continuously flakes off, checks into very distinctive five-sided grayish-purple plates. The tree is one of the largest in the sub-alpine forests and may be distinguished (a) by its five-needle bundles which range from two to four inches in length, (b) by its long feathery cones (length five to eight inches) which are borne in clusters at the ends of the long straight branches, and (c) by the very characteristic five-sided small plates in the bark of the older trees.

Hardest of all Yosemite trees is the five-needled **white bark pine** (*Pinus albicaulis*). A few large specimens $2\frac{1}{2}$ feet in diameter and up to 30 feet in height are sometimes encountered between 9000 and 10,000 feet elevation, but the species is most evident at timberline where it forms a scattered forest of dwarf or prostrate trees. These trees, always in keeping with their bleak surroundings, are the delight of the

mountaineer. In early spring the raspberry-red of the fragrant flowers, the chocolate brown or purple of the immature cones, the yellowish-green of the short leaf-tufts, and the silvery white bark of the branches and trunk contrast most harmoniously. Specimens may be identified (a) by having five short leaves per bundle (length $1\frac{1}{2}$ to $2\frac{1}{2}$ inches) which are tufted at the ends of the flexible branchlets, (b) by the small hard cones (about the size of a hen's egg), and (c) by the smooth white bark.

Least important of the park's three yellow pines is the **digger pine** (*Pinus sabiniana*) of the low dry foothill country. Its wide-branching habit and sparse silvery gray foliage set it apart from all other species. Most important of its distinguishing characteristics are (a) the gray-green clusters of long flexible leaves (length $8\frac{1}{2}$ to 12 inches) which occur three in a bundle, (b) the low-branching habit, and (c) the large heavily armed cones which generally remain on the trees.

The **western yellow pine** (*Pinus ponderosa*) and the **Jeffrey pine** (*Pinus jeffreyi*) are so closely related that even botanists differ as to their separation. Both trees reach a large size (maximum diameter 8 to 10 feet) and are tall and symmetrical. They are exceedingly abundant within the park and form the greater part of the forests of Yosemite Valley. The rich green foliage is made up of three-needle bundles which range from 5 to 11 inches in length. The flaky bark of all older trees is distinctively divided into large yellow plates by deep fissures. The two species grow abundantly from 3000 to 7500 feet elevation, the western yellow pine preferring the lower altitudes and the Jeffrey pine the heights. The chief contrasts

between the two species are (a) in the cones, which are $2\frac{1}{2}$ to $5\frac{1}{2}$ inches in length in the western yellow pine and $5\frac{1}{2}$ to $11\frac{1}{2}$ inches in the Jeffrey pine, (b) in the bark which is yellowish-brown in the former and reddish-brown in the latter, and (c) in the foliage which is a deep yellow-green in the former and a dark blue-green in the latter.

The only two-needle pine of the park, the **lodgepole pine** or "tamarack" (*Pinus contorta*), forms extensive forests at elevations of 7000 to 9500 feet—indeed, it is so abundant as to be the one plebian tree of the High Sierra. In general the tree is not more than 2 feet in diameter and 50 feet in height, but much larger specimens may be found. The species may be distinguished (a) by its two-needle bundles which range in length from 1 to $2\frac{1}{2}$ inches and are generally curved, (b) by its small cones (length $\frac{3}{4}$ to $2\frac{1}{2}$ inches), and (c) by its thin, flaky, purplish bark.

The only known specimen of the **one leaf pinyon** or **nut pine** (*Pinus monophylla*) in the park grows in Pate Valley in the gorge of the Grand Canyon of the Tuolumne. It probably sprang from a seed carried over the mountains by the Indians from the Mono Lake region where the nuts of this small tree form an important part of the food of the natives.

Of the four American hemlocks but one species occurs in the Sierra Nevada. The **mountain hemlock** (*Tsuga mertensiana*) ventures southward from Alaska along the mountain sides, ascending higher and higher until, in Yosemite National Park, it is found only in alpine forests above 9000 feet elevation. It is universally proclaimed the most graceful tree of the mountains. The beautiful drooping tip and branches set it aside from all other conifers, and its customary



PLATE XX

Western Juniper Trees at Benson Lake

Photo by A. C. Pillsbury

bleak surroundings only enhance its graceful charm. The tree may easily be distinguished (a) by its drooping habit, (b) by the short, petioled leaves $\frac{1}{2}$ to $\frac{3}{4}$ inches in length which clothe the branchlets all around, but sometimes have the appearance of being grouped in star-shaped clusters, and (c) by the small pendulous papery cones (length $\frac{1}{2}$ to 3 inches) which adorn the ends of the branches.

The **Douglas fir** (*Pseudotsuga taxifolia*) is the most important timber tree in the world. In Oregon and Washington it forms great forests, but here near the southern limit of its range we find it sparsely mixed with other species of the middle altitudes. There are some splendid old specimens in the cool shade of Yosemite's great south wall and on the talus slopes up to 6500 feet elevation. The tree is most easily recognized (a) by its medium sized pendulous cones which are two to four inches in length and have trident-shaped bracts sticking from between the scales, (b) by its drooping lower branchlets which are clothed all around with petioled leaves from $\frac{3}{4}$ to $1\frac{1}{4}$ inches in length, and (c) by the thick, deeply furrowed ashy brown bark.

The true **firs** (genus *Abies*) differ from all their American relatives of the Pine Family by bearing *erect* cones. These generally occur at the very tips of the trees, and since the scales and seeds are shed one by one and blown away by the winds, they are almost never found beneath the trees. Of our nine American firs two species inhabit the Sierra Nevada. The **white fir** (*Abies concolor*) is common at middle altitudes, ranging from 3500 to 8000 feet, while the **red fir** (*Abies magnifica*) claims the higher slopes. Both species are beautifully symmetrical with erect, narrow,

dense, spire-like crowns and delicate regularly whorled branches. All firs are lovers of shade and therefore grow in dense stands crowding out the less tolerant species. The **white fir** may be identified (a) by the leaves, which are 1 to 2 inches long, without leaf stalks, and flattened or two-ranked on the lower branchlets, (b) by the bark which in the younger trees is white and bears balsam blisters and in the older trees is deeply furrowed, corky, and ashy gray in color, (c) by the cones which are 3 to 5 inches in length and borne erect near the tops of the trees, and (d) by the habitat, the tree generally occurring at middle altitudes as an associate of yellow and sugar pines. The **red fir** (*Abies magnifica*) may be identified (a) by its short needles $\frac{3}{4}$ to 1 inch in length which generally curl upward on the branchlets, (b) by the bark which in the young trees is silvery gray but in middle aged and older trees is a deep carmine-red and divided into small plates, (c) by the large cones 6 to 8 inches in length, which are borne near the tips of the trees and generally have bracts sticking from between the scales, and (d) by the altitude, the tree generally occurring between 7500 and 9500 feet elevation.

The **Redwood Family** (*Taxodiaceæ*) is represented in the United States by only three species and in Yosemite National Park by a single species, the **giant sequoia** (*Sequoia gigantea*). This tree, widely famed as the oldest and largest living thing, occurs in but twenty-six groves which are all found in the middle elevations of the Sierra Nevada from the vicinity of Lake Tahoe on the north to the region about Kings River Canyon on the south. There are three groves in the park, the nearest to Yosemite being 17.2

miles distant. The following chapter is entirely devoted to the habits and history of this most wonderful tree. In its natural habitat the tree is seldom confused with any of its associates. Among its distinguishing characteristics are (a) the massive clear trunks with their cinnamon- or chocolate-brown fibrous bark, (b) the closely overlapped leaves which are awl-like on the lower part of the tree and scale-like near the top, and (c) the brilliant brown cones which vary in length from $1\frac{1}{2}$ to 3 inches.

The members of the **Cypress Family** (*Cupressaceæ*), in which are the many so-called American cedars, all have scale-like leaves and stringy fibrous bark. Two Yosemite trees belong to this family. The **incense cedar** (*Libocedrus decurrens*) is one of the most abundant trees in the Valley and on the talus slopes above. The vivid green of its perfectly formed crown contrasted with its fluted brown trunk make it a constant object of admiration. Chief among the distinguishing characteristics are (a) the flat sprays which are made up of scalelike leaves, the bases of which are closely adherent to the branchlets, (b) the small cones which range from $\frac{3}{4}$ to $1\frac{1}{4}$ inches in length and are made up of five (apparently three) scales, and (c) the golden- or cinnamon-brown fibrous bark.

The **western juniper** (*Juniperus occidentalis*) is an inhabitant of the upper slopes and is generally found above the Valley rim on exposed rocky sites where its gnarled form picturesquely decorates the bare granite pavements. Scattered specimens may be found struggling upward in most unhospitable places almost to timberline. The characteristics which easily identify the species are (a) its gnarled form, (b) its thin, stringy, light cinnamon-brown bark, (c) its tiny scale-

like leaves which are arranged in whorls of three around the branchlets and are closely pressed to the twigs, and (d) its fruit which is a small blue berry with a sweetish, pungent, aromatic taste. The berries are really modified cones.

A most interesting little evergreen is the **California nutmeg** (*Tumion californicum*), a close relative to the conifers. A few specimens may be found in the canyon of the Merced below Cascade Falls. The sharp-pointed needle-like leaves which range in length from 1 to 2 inches are flattened in two ranks along the branchlets and omit a very characteristic pungent odor when bruised. The fleshy fruits average about 1½ inches in length and have a hard-shelled kernel which, when dried, looks much like the nutmeg of commerce.

The broad-leaved trees of the park are of comparatively little importance—far less so than would appear from a casual inspection of the oak-dotted floor of Yosemite Valley. These deciduous trees grow at the lower elevations and prefer the rich bottomlands and moist stream margins. The oaks are predominant. In the hot foothills is the **valley white oak** (*Quercus lobata*) which, in the region about El Portal is replaced by the **California black oak** (*Quercus californica*), gigantic specimens of which may be seen throughout the canyon of the Merced and in Yosemite Valley. The latter may be distinguished by its large leaves, the deep lobes of which are sharply pointed, and by the dark bark which is deeply checked into small plates. The talus slopes above the Valley floor are the favorite habitat of the **canyon live oak** (*Quercus chrysolepis*) which may be distinguished by its whitish bark and by its small entire and toothed leaves on the same twigs, the old leaves being lead color beneath,



PLATE XXI

Mountain Hemlocks on the rim of Matterhorn Canyon

Photo by Walter L. Huber

and the young leaves yellow powdery beneath. Above 5000 feet one commonly finds the dwarf **huckleberry oak** (*Quercus vaccinifolia*), a shrub 4 to 8 feet high which much resembles the canyon live oak.

Another common tree of the talus slopes is the **California laurel** or "**bay**" (*Umbellularia californica*). The evergreen, smooth, shiny leaves have a most agreeable camphoric-pungent odor when crushed, and are dried and used for spice. The yellow flowers of early spring develop into olive-like fruits which mature in autumn.

Along the streams, especially within the Valley, are a number of moisture-loving species. Of these the tree which excites the most admiration is the **flowering dogwood** (*Cornus nuttallii*). In early spring the showy white flowers (really modified flower-bud scales) appear even before the leaves and often completely cover the crown. In autumn the clusters of bright red fruit and brilliant red, orange, and yellow foliage make it the most beautifully colored of all Yosemite trees. The **broadleaf maple** (*Acer macrophyllum*) is abundant in moist shady spots, especially in the shadow of the great south wall of the Valley and in the deep canyon of the Merced at its head. The **dwarf maple** (*Acer glabrum*) has been reported from Yosemite but is very rare. The **alder** (*Alnus rhombifolia*) is never found far from water. It may easily be identified by its rather coarsely veined, toothed leaves and by the peculiar little cones which are retained on the trees after the seeds are shed. Twelve species of willow occur within the park but all except the **yellow and black willows** (*Salix lasiandra* and *S. nigra*) are shrubs. The **black cottonwood** (*Populus trichocarpa*) is the largest of our poplars. It is a common tree of the moist bottomlands of middle

elevations and may be distinguished by its yellowish white bark and by its thick leathery leaves which are deep shiny green above and silvery white beneath.

The little **quaking aspen** (*Populus tremuloides*) is one of the most lovable of all mountain trees. When unexpectedly found in meadows and garden spots of the High Sierra it is always an object of delight. The small delta-shaped leaves which are yellow-green above and silvery beneath are so fastened to their twigs that they tremble with the least breeze. This characteristic, together with the smooth, white bark make it impossible to confuse the tree with any other species.

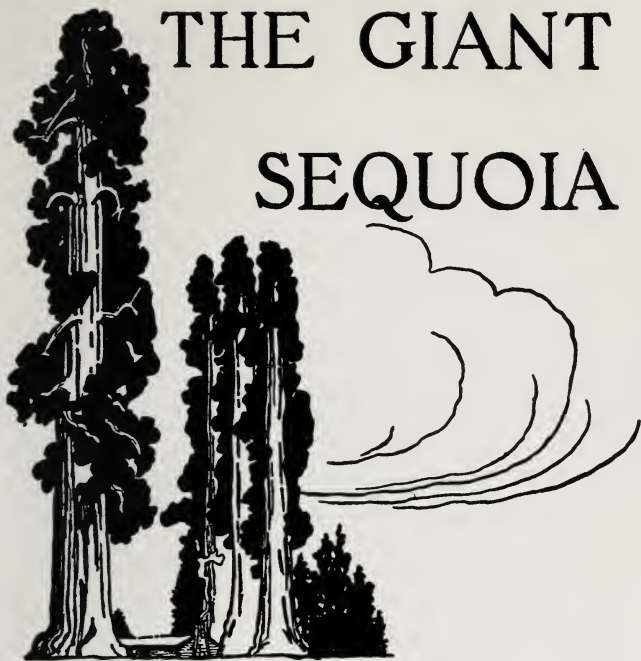
The **mountain mahogany** (*Cercocarpis parvifolius*) is a small tree of the foothill region. Being generally found in the chaparral areas it enters the park only in the lower reaches of the great canyons. Specimens may be taken in the region about El Portal.

By using the *Key to the Conifers* presented in the Appendix of this volume one may easily identify any evergreen in the park.

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THE GIANT SEQUOIA



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THE Big Tree or *Sequoia gigantea* is one of the most charmingly attractive features of Yosemite National Park. This most wonderful and most lovable of all tree species occurs in scattered communities or "groves" on the western slopes of the Sierra Nevada Mountains between the elevations of 4600 and 8000 feet.

Of the twenty-six groves, the northernmost, near Lake Tahoe, contains but six trees. Further southward the species becomes more and more abundant until, in the region near the Kings and Kern Rivers, great forests are formed. The largest and most famous of these is the Giant Forest of Sequoia National Park.

Within Yosemite National Park are three groves. The Tuolumne Grove, about $1\frac{1}{2}$ miles west of Crane Flat on the Big Oak Flat Road, contains 40 trees which occur at about 5800 feet elevation. The Merced Grove, about 3 miles east of Hazel Green, contains 33 trees and is traversed by the Coulterville Road to Yosemite at an altitude of 5500 feet. The Mariposa Grove 4 miles southeast of Wawona on the mountain heights above the South Fork of the Merced River contains 490 mature trees.

This latter grove is in a number of respects the most remarkable of all clusters of the Big Trees which occur in the society called the "grove." It really consists of two almost distinct groups of trees, the upper grove of 364 trees at an altitude of 7000 feet, and the lower grove of 126 trees at an elevation of 5400 feet. The road first enters the lower grove, passing between the Four Sentinel trees, with the fifth, the Sergeant of the Guard, standing a little apart. Soon a cluster of large Sequoias comes into view. Among these, prostrate, lies the Father of the Forest along whose trunk a six-horse stage has been driven and at one time a whole troop of cavalry lined up in formation.

The road winds upward and tunnels directly beneath the base of the Wawona Tree through a passage sufficiently large for the largest of old-time stage coaches and modern auto-busses. Beyond this point is the Alabama Tree which is considered the most perfect and symmetrical tree in the grove. After passing many individuals which ennoble the forest by their commanding size, the roads of the grove finally center at the Big Tree Cabin which is set amid a cluster of truly magnificent specimens of this wonderful race of forest giants. All of these trees have been individualized with favorite names, such as Ohio, Massachusetts, General Lafayette, St. Louis, Philadelphia, Galen Clark, and many more. The Old Guard consists of four very fine trees in a row. The four trees of the Diamond Group are so disposed that they form the corners of a diamond. About ninety-eight trees of the upper grove and thirteen of those in the lower grove have received names.

The dimensions in feet of a number of the more remarkable trees of the Mariposa Grove as given by



PLATE XXII

Big Tree Cabin in the Mariposa Grove. The cabin was built about 1860 by Galen Clark

Photo by A. C. Pillsbury

the Department of the Interior "Circular of General Information regarding Yosemite National Park" for 1919 are shown in the following table:

<i>Tree</i>	<i>Height</i>	<i>Diam. at 10 ft.</i>	<i>Diam. at Base</i>
Mark Twain	331	13.0	16.9
Capt. A. E. Wood	310	12.7	16.5
Columbia	294	16.5	25.6
South Carolina	264	17.3	23.5
Washington	235	20.7	29.3
Forest Queen	219	12.1	17.0
Grizzly Giant	204	20.5	29.6

The height of the Big Tree commonly averages from 125 to 225 feet, but trees in excess of these figures are well known. The best authenticated of recent figures of the extreme heights of known trees are those for the General Sherman Tree in Sequoia National Park which is 279.9 feet high and for the Dalton Tree in the Muir Grove which is 292 feet high. These appear to be extreme figures for trees in the forests of the southern Sierra Nevada. The Columbia Tree in the Mariposa Grove is 294 feet high and the Mark Twain Tree is said to be 331 feet high, a figure in excess of any measurements hitherto given which have been made by presumably accurate methods.

Height is a matter which can be determined with fair degree of accuracy and when determined is not variable. Diameter, on the other hand, is not so definitely determinable. Diameters at the ground do not, in many cases, give significant or proportionate values to the trunks for the reason that the Big Trees often swell excessively at the base. The writer has found by actual measurement that the diameter at the base in certain cases is twice that at ten feet above

the ground. The only figures valid for purposes of comparison must therefore be taken sufficiently above the ground to minimize the error due to this factor. As so many people have a natural interest in the largest known diameters there are here given the diameters of the four most famous trees:

<i>Name of Tree</i>	<i>Diameter at 12 ft.</i>	<i>Diameter at ground</i>
General Sherman (Sequoia Park)	27½ ft.	34⅓ ft.
General Grant (General Grant Park)	23 "	35¾ "
Grizzly Giant (Mariposa Grove)	20 (at 11 ft.)	31⅙ "
Boole Tree (Converse Basin, King's River)	25¾ (at 10 ft.)	36 "

It must here be emphasized, however, that characteristically the taper is very slight. Indeed, all observers unite in agreeing that the outstanding feature of the Big Tree, more remarkable and impressive than any other, is the columnar character of its trunk. The great height of the clear column and the manner in which it maintains its diameter upward from the ground to the crown are most extraordinary.

In the matter of longevity the Big Tree is undoubtedly the oldest living thing on the planet. Its age varies from 900 to 2100 years and in not a few cases it probably attains to an age of 3000 years. The age of one tree logged in the Converse Basin has been determined with closely approximate accuracy as 3148 years. This is the oldest tree of which we have any definite record.

Standing in rhapsodical admiration before a *Sequoia gigantea* one can easily imagine it to be

5000 or 10,000 years of age. The figure eight thousand years has been placed on the Grizzly Giant at the instance of a distinguished authority on fishes. As a matter of fact no one knows the age of the Grizzly Giant as there is no satisfactory way of determining its age except by cutting it down. A small core could be taken from its trunk by a special tool, but this means might not prove satisfactory, and such mutilation is not likely to be permitted. There is no way of determining the age of a particular individual merely by means of the diameter. From various age studies I have found, on the average, about 20 years to the inch. The Father of the Forest in the Calaveras Grove has a diameter of 27 feet inside the bark at about 8 feet above the ground. Its calculated age would therefore be 6480 years. When cut down its age was determined to be about 1300 years. In the Converse basin the writer determined the age of a tree 11 feet 7½ inches in diameter to be 2019 years. The ring count was accurate within a possible error of only 10 or 15 years in either direction. Another tree 24 feet in diameter, twice the diameter of the first, was only 1346 years old—a little over half the age of the first. Trees of various species often take on an appearance of great age when comparatively young, due to storm, wind, disease, or under-nutrition. Senility or its appearance is not always a matter of years, and attempts to assign a longevity of four thousand years or more to the Big Tree rest on no substantial basis.

The age of individual Big Trees, however imposing their life, should not be confused with the age of the Sequoia race. The Big Tree is *descended from* pine-like ancestors, and the Pine Family itself and its allies

are very much older racially than the Redwood Family to which the Big Tree belongs. The morphology of the flowers and cones of a pine, not to speak of the presence of resin, indicate a family very much older than the Redwood Family. Measured in terms of history of life upon this earth, the species of *Sequoia* are recent; they are relatively modern compared with the pines, firs, and spruces, and their allies—indeed, they are the merest parvenues.

In another sense they have a highly dignified ancestry and represent a race of trees which were once more numerous upon the surface of the earth than at present. During the Miocene age of the Tertiary period many species of *Sequoia* were distributed over the northern hemisphere and perhaps also occurred in the southern hemisphere. At any rate the remains of *Sequoia* species have been observed in the rocks of Austria, France, England, western Asia, Spitzbergen, at the mouth of the Mackenzie River, British Columbia, Yellowstone Park, Oregon, and many other stations. They undoubtedly formed very extensive forests during the Miocene period. It is supposed that during one of the glacial ages all the species became extinct excepting the two which are now living in California, viz., the Big Tree of the Sierras (*Sequoia gigantea*) and the Redwood of the Californian Coast Ranges (*Sequoia sempervirens*).

Of these two species the Big Tree grows to a much more colossal size. It begins as a young tree with the pyramidal outline of an arbor-vitæ, its trunk clothed with branches to the ground and its crown tapering to a cone-like apex. After it attains to the age of two or three hundred years it becomes a tree 75 to 125 feet high, and begins to prune its trunk of

branches from the ground upwards. As it goes into the adult period, the crown continues to move upward and a clear shaft results which is 100 to 150 feet or more up to the first limb and clothed with a deeply furrowed fibrous red bark which is very non-inflammable.

The Sierran forest is typically a fire forest; that is to say, all the tree species have shown reaction in structure or life history to long continued fires which have undoubtedly run over California woodlands for many thousands of years and perhaps for a longer period. The trunks of the pines, firs, and cedars have become encased in exceedingly thickened bark which is undoubtedly a very effective protection to the vital cambium layer which lays between the bark and the wood and provides for the tree's increase in thickness. The bark of these trees, on the other hand, contains more or less resin which increases the fire hazard.

In the case of the Big Tree, however, there is practically no resin in the whole trunk. Resin is found not at all in the tree except in microscopic quantities in the first annual layer of wood, in the leaves, and in the staminate catkins. The bark is quite free from resin except for its possible occurrence in case of mutilation, and by its peculiar fibrous nature forms an almost asbestos-like covering to the trunk. This bark is a beautiful red-brown or cinnamon color six to twelve inches thick. It often attains a greater thickness, and bark two feet through is actually known. Fires burn through this heavy layer of bark very slowly, and it is only after repeated conflagrations that the Forest Fiend obtains entrance to the woody layers. Even then progress is slow because the wood is non-resinous and burns slowly. Nearly all mature

trees or trees past maturity show signs of fire ravage, although in many cases the attack has been negligible.

As the tree grows on past maturity it eventually begins to die in the top. This may be the result of the gradual exhaustion of its food supply or it may be due to years of deficient seasonal rainfall. It is possible that the tops of Sequoias *may* be killed by lightning, but we know of no direct evidence to this effect. We certainly have no record of a Sequoia tree ever having been killed by lightning, although pines, firs, and other trees of the Sierran forests are frequently killed or completely shattered. Probably all old trees of *Sequoia gigantea* have been *struck* by lightning; certainly very many of them within the period of the white man's observation.

One of the most remarkable of forest experiences is to see at night a fire burning 150 or 200 feet in the air in the very tip-top of a great Sequoia tree. Such fires are set by lightning. On account of their inaccessibility and their tendency to throw off live sparks, they are a great source of worry to the forest ranger who can do nothing but camp in the neighborhood until the fire burns itself out or is extinguished by a propitious rainfall.

The cone of the Big Tree is two to three inches long and bears two hundred to three hundred seeds, about twenty-five per cent. of which are viable. It is quite common to hear tourists marvel at the ridiculously small size of the cone borne by so gigantic a tree, but the complacent tourist may well be thankful that the size of the cone does not correspond to the size of the tree beneath which he stands with admiring gaze.

In some of the rhapsodies which have been spoken

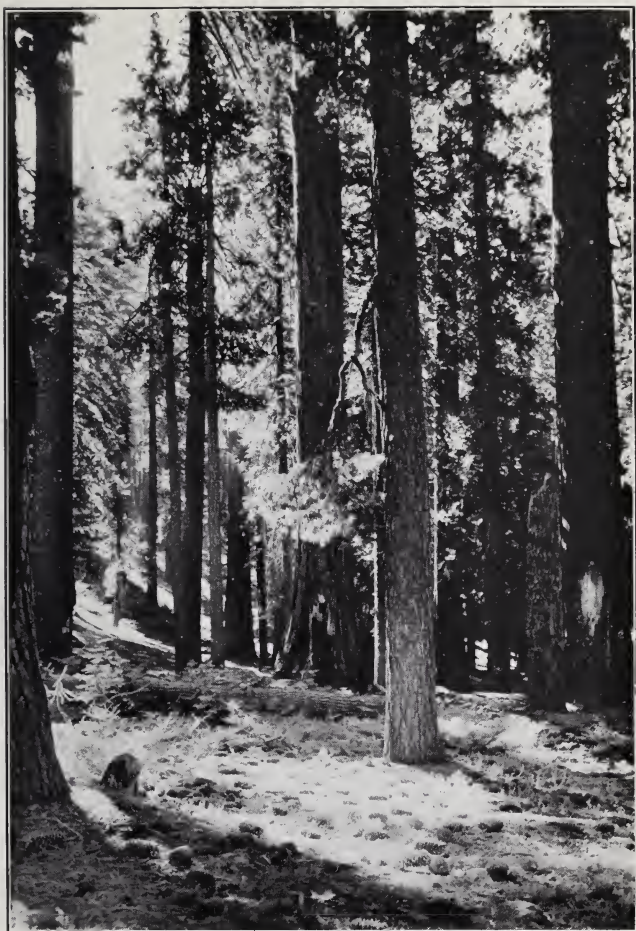


PLATE XXIII

Typical forest in the Mariposa Grove. Left to right, Sugar Pine, Red Fir, Incense Cedar, Sequoia, young Sugar Pine, group of Firs, and Sequoia. The ground is covered with Sugar Pine cones

Photo by A. C. Pillsbury

or written about the *Sequoia gigantea*, it is the habit to speak of this tree as passing out, as a relic, as making its last stand upon the western flanks of the Sierra Nevada, and as being a decadent survival. In a sense it is a survival but it is a most lusty and vigorous survival. No other tree grows to so great a size; no other tree has such longevity; and no other coniferous tree has such resistance to disease except its cousin the Redwood of the Coast. In open spaces in the forest, seedlings appear in great numbers, especially in the southern part of the range of the species. Here they often form weedy thickets through which it is impossible to force one's way. In the southern Sierra Nevada the Big Tree forms extensive forests, and is often the dominant tree in its areas of best development. The species is so abundant that it has been lumbered on an extensive scale and many millions of board feet of lumber from the Big Tree have been put on the market and sold as Redwood.

The appearance of the wood does not differ very much from that of the well-known Coast Redwood. It is much the same color, texture, and weight. The difference in strength can well be illustrated by observing that in Tulare County vineyards, grapevine stakes made from Big Tree wood are two inches square, while in Napa Valley vineyards, similar stakes made from Redwood are about one inch square. Redwood resists a far greater lateral strain than the Big Tree wood. The latter has a tendency to fracture transversely when split, whereas the Redwood splits cleanly throughout. One sometimes sees in the beds of Sierran rivers huge but short logs which are broken off squarely at the ends. These great leviathans have been weathered by successive floods and are

often smoothed by rolling from side to side of the canyon wall. They are fractured segments of the trunks of the great giants of the Sierra.

In the Big Tree, the Sugar Pine, the Yellow Pine, the Red and White Firs, and the Incense Cedar we have in this Yosemite region the finest and most remarkable group of conifers in the world. They serve to give the park an interest and charm which highly gratifies our æsthetic sense and stirs deeply our imagination regarding this earth upon which we live. The Big Tree and the Yellow Pine would be fit tenants for Paradise, and this region is Paradise enow.

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FLOWERS OF YOSEMITE NATIONAL PARK

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FLOWERS OF YOSEMITE NATIONAL PARK¹

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YOSEMITE NATIONAL PARK offers a remarkably rich field for the botanist. The same factors which determine the great diversity of animal life influence to a much greater degree the species and forms of plant life. Some plants have become highly specialized to endure the many months of drought in the semi-arid foothills, while others have developed a hardiness which enables them to exist in the bleak reaches above timberline. Even in the middle regions where optimum conditions attain, the exuberant abundance of wild blossoms changes in character with each change of site; each species seems to have its own niche, whether it be in swamp, on fertile hillside, or on desiccated granite barrens. Indeed, so great is the range of natural conditions to be encountered in the park between the foothills and the mountain glaciers that there are no

¹Based upon the botany series of the LeConte Memorial Lectures delivered by Dr. Jepson in Yosemite, June, 1918.

Pages 253, 258, 259, and 260 were, under Dr. Jepson's direction, either written or expanded by me. This paper was also used by me for reference in preparing my article in the *Sierra Club Bulletin* for January, 1921, but credit for the portions on the Snow Plant and one or two other species was inadvertently omitted.

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less than twelve hundred species and varieties of flowering plants and ferns native to this area. While most of these are typical of the entire Sierra Nevada, many are exceedingly rare, and a few species are only known from small areas within the park.

By whichever route the traveler enters Yosemite, he will pass through the shrub formation known by the Spanish name **chaparral**. So densely does this society clothe its area in the Upper Sonoran or Foothill Zone that it is often impossible to force one's way through it. The various shrubs which go to form this close cover are of much the same stature and aspect, and form a remarkably uniform population on exceedingly dry and well-drained slopes. The excessive drought, the high summer temperature, and the rocky or gravelly nature of the soil are the chief factors which have caused these various chaparral shrubs to develop many characteristics in common; of these the most striking are their dwarf habit, reduced leaf surface, small flowers, hard close-grained wood, and rigid thorny branchlets. It is only superficially, however, that these shrubs are alike. They are derived not from one family, nor two, nor three, but represent the pioneer spirit in many different stocks which have successfully met the conditions imposed by Nature in the chaparral area.

One of the most important and abundant of these shrubs is **Buck Brush** (*Ceanothus cuneatus*), a gray bush five to eight feet high with tough thorny branchlets, opposite leaves, and hard close-grained wood. It is everywhere abundant, and its short blunt spurs make it a terror of the cattlemen riding the range. The small white flowers are in themselves insignificant, but a profuse production of small honey-scented clus-



PLATE XXIV

Washington Lily (*Lilium Washingtonianum*)

A fine species which fills the Yellow Pine forest with a
delightful fragrance

Photo by A. C. Pillsbury

ters causes the shrubs for a time to take on a delicate hue. An allied species is the **Jack Brush** (*Ceanothus divaricatus*), with longer flower clusters and alternate leaves, which occurs in the canyon of the Merced nearer the Valley. All species of *Ceanothus* are commonly though incorrectly known as "California Lilac."

In approaching the Valley from El Portal, if early enough in the year, one will be rewarded with the sight of that unusual glory, the **Redbud** (*Cercis occidentalis*). Before the foliage even hints at showing its tender green leaves the tree is shrouded in a cloud of red blossoms. It belongs to the Pea Family and in summer its branches are heavily hung with purplish pods. Along the streams at the same altitudes is the **Wine Bush** or **Sweet Shrub** (*Calycanthus occidentalis*), a bush with large opposite leaves, aromatic flowers, and red-brown sepals and petals which are borne on a cuplike base. Farther up the canyon of the Merced one of the most pleasing sights in early summer is the **Philadelphus** (*P. lewisii* var. *californicus*) which is similar to the *Syringa* of Eastern gardens. It forms fragrant thickets along the stream banks and because of its somewhat orange-like flowers is often called **Mock Orange**. It is perhaps rivaled by its associate, the **Bladdernut** (*Staphylea Bolanderi*) which grows in the canyons of the foothills, especially above El Portal near Pulpit Rock. The Bladdernut has its leaflets in threes and covers itself with white drooping flower clusters which later develop into curious bladder-like three-horned seed pods. It was first collected in 1874 by Dr. Henry N. Bolander, one of the early botanical explorers of the Yosemite region.

Everywhere the shrubs lend interest and charm to the mountain sides and the open forest floors or valley

levels. Foremost among these stands the **Deer Brush** (*Ceanothus integerrimus*) with its tall slender stems, scattered foliage, thin leaves, and abundant masses of delicate white blossoms. The foliage of this bush is eaten by the deer and it is also an important browse for cattle. Chemical analysis indicates that its leaves have a higher nutritive value than those of any other native shrub. It is when the Deer Brush is in bloom, however, that it most attracts the eye of the traveler. The thickets with their dainty plumelike flower-clusters borne aloft on slender branchlets form a billowy mass of white over considerable forest areas. A less common species is a close relative, the **Sweet Birch** (*Ceanothus parvifolius*), which is found in the Mariposa Grove, about Chinquapin, in the vicinity of Grouse Creek, and at similar altitudes. It inhabits open spots in the forest where its stems spread out and form the root crown in a somewhat wheel-like fashion. Its diminutive shiny leaves and small clusters of flowers in delicate shades of blue make it an attractive asset of the forest floor.

As the traveler enters the Valley his views of the Merced River will often be enhanced by the abundant bloom of the **Western Azalea** (*Rhododendron occidentale*) as it contests for a place among the willow thickets. In June or July its sweet fragrance charms one to follow the stream and see its beauties. Often the great flower-clusters nod to the stream and almost dip their delicate orange and white petals into the swiftly running water.

But it is the Valley floor with its riotous wealth of color which in favorable seasons shows best the variety of the native vegetation. In late spring or early summer the meadows are carpeted with great masses

of bright flowering annuals and taller brilliant perennials. The delicate **Canchalangua** (*Erythraea venusta*) with its showy clusters of bright pink flowers; the taller **Collomia** (*Gilia grandiflora*) with its dense heads of dainty funnelform flowers, cream to almost salmon in colour; many patches of golden **Mimulus** or **Monkey Flower**; countless blue flowers, such as the light blue **Pentstemon** (*P. confertus*) with its flowers in whorls on tall stems; tall blue "**Forget-me-nots**" (*Lappula velutina*); tiny dark blue **Collinsia** (*C. parviflora*) and the larger almost white *Collinsia tinctoria*; the red **Indian Paint Brush** (*Castilleja miniata*); the brilliant scarlet **Pentstemon** (*P. bridgesii*) with lance-shaped leaves and funnelform corolla about one inch long; and quantities of golden **Buttercups** (*Ranunculus occidentalis* var. *eisenii*), all go to form the brilliant mosaic of large sheets and pools of color on the Valley levels.

At altitudes of 3600 to 5000 feet, after the shallow springtime pools have evaporated, these areas become midsummer beauty spots with a thick growth of *Downingia montana*. This is a little **Lobelia** with delicate jewel-like blossoms, the upper lip very small with two minute lavender lobes, the lower lip of three broad-spreading lobes, white at the throat, and with a bright blue border. A mass of these dainty blue flowers is the loveliest sight imaginable and may be seen in Hetch Hetchy Valley and on the Hog Ranch Road to Crocker's Station.

One of the plants found in Yosemite Valley and at similar altitudes which receives especial attention from the traveler is the **Bleeding Heart** (*Dicentra formosa*). Its leaves are finely cut and its flowers are pendulous in clusters from the summit of the stem.

The flower itself is flattened, of a rose-purple color, and about three fourths of an inch long.

Another striking plant of moist or swampy places is the **Scarlet Monkey Flower** (*Mimulus cardinalis*). The rich green foliage, soft with hairs, makes a beautiful setting for the large brilliant flowers. These gorgeous plants may be seen in several places in the Valley, usually by streams or near the bases of the waterfalls.

One of the remarkable sights of the upper reaches of the Valley in midsummer are the fields of tall yellow **Evening Primroses** (*Oenothera biennis*). They have very handsome large golden flowers which open at twilight and close again in the middle of the following day. In favorable seasons the dry open fields about Yosemite are often yellow with these stately plants. Many of the finest groups, however, are now a thing of the past, due to the mowing of the meadows for wild hay.

In the edges of brushy thickets one finds the **Wild Ginger** (*Asarum Hartwegi*) with its broad mottled leaves and its curious purple flowers close against the ground. It is one of the most singular plant inhabitants of the Valley floor and is always worth searching for in May and June.

In dry spots near the Yosemite Black Oaks, the **Sierra Milkweed** (*Asclepias speciosa*) develops its bunches of highly specialized pink or reddish-purple flowers above its white hoary leaves and is a most interesting plant on account of its habit of catching and imprisoning flies.

Along the roads one may see in May or June the **White Mariposa Lily** (*Calochortus venustus*). This is one of the handsomest of all Mariposas and is remarkable for its range of color. Along the Wawona Road

one form has deep wine-red petals which are darker toward the middle and are crossed below by a broad yellow band; still other plants, the more usual form, are nearly white with a dark brown eye surrounded by yellowish shadings.

The Lily Family is well represented by many other interesting species. The **Tiger** or **Leopard Lily** (*Lilium pardalinum*) occurs in such places as Bridal-veil Meadows where as many as twenty-eight flowers have been counted on a single plant. The **Little Tiger Lily** (*Lilium parvum*) has flowers about half as large and grows in moist meadows at higher elevations.

On the walls of the Valley are several rarities, one of them being the **Cliff Buttercup** (*Ranunculus hystriculus*). Its sepals are white and petal-like and the petals, which are small and inconspicuous, are developed as spoon-shaped nectaries. The whole flower looks more like an anemone than a buttercup and has a great historical interest as it is in reality one of the most ancient of flowering plants. It grows on cliffs and ledges where it is reached by the spray from Yosemite Falls, Vernal Falls, Nevada Falls, and other cataracts about the Valley. It is as delicately beautiful as it is rare.

Leaving the Valley and passing into the main pine belt (Transition Zone) one finds many interesting plants. Here the **Deer Brush** and **Manzanitas** cover great areas. A very abundant plant is the **Mountain Misery** (*Chamabætia foliolosa*). There is no mistaking it. The strawberry-like flowers (which it comes by honestly since it is a member of the Rose Family) and the fernlike foliage mark it distinctively. The woody stems grow six inches to two feet high and colonize, almost to the exclusion of other herbs, miles

and miles of the open slopes and flats beneath the pines in the Yellow Pine belt. It is sometimes called Bear Clover or Tar Brush, but the true folk name, Mountain Misery, is a better term, for it comes right from the soil and is born of the daily work and experience of the mountain rancher. He cannot trail his animals through it, for they leave little or no track in this growth; the foliage has a tarry secretion which gums up his clothing; and the herbage is offensive to his cattle and so it is useless as a fodder plant. To the mountain rancher, then, this herb is the last word in expression of the day's discontent and inadequacy. To many a mountain-lover, however, its spicy odor suggests the many drowsy sunny days spent beneath the pines.

Beneath the Yellow Pines on the road from Yosemite to Wawona the Tuolumne and Merced Big Tree Groves the ground is often covered with the green carpet of the **Mahala Mats**, a species of *Ceanothus*. It has small clusters of blue flowers, leaves spiny at the tips, and distinct horns on the seed pods. The mats are closely grown and, while irregular in shape, often become five to fifteen feet broad.

Of all rarities in the park no other plant excites so much popular interest, perhaps, as the **Snow Plant** (*Sarcodes sanguinea*). It is a very Mephistopheles amongst plants, and its dazzling red color has exercised a strange and almost weird fascination upon the popular mind. The whole plant—flowers, bracts, and stems alike—is of a bloody red hue. It springs up from the leafy mold of the forest floor, and (as the police judge would say) is without obvious means of support, since it has no chlorophyll, no green leaves, to manufacture its own food as most other plants must



Red Heather
(*Bryanthus Brewerii*)

PLATE XXV
Evening Primrose
(*Oenothera biennis*)
Photos by A. C. Pillsbury

Indian Paint Brush
(*Castilleja miniata*)

do. While called a parasite *it is not such* and does not draw its sustenance from the living tissues of another plant. It is a saprophyte—that is, it lives on dead and decaying vegetable matter. Its stems rise from an underground, very much involved, interlaced, and compact mass of coralline roots which gather up its food materials. One, two, three, or four stems rise from this root mass, or sometimes a cluster of a dozen. The writer has even found as many as sixteen. The Snow Plant has not anything to do with snow any more than many other Sierra plants which come up after the snow or snow banks have disappeared. Probably the Snow Plant has never been seen rising from *winter snow*. After the stems start up through the layer of pine needles or forest mold and after the stem is once above the ground, a light snowfall may come and the blood-red stems may thus appear to have risen through this virgin snowfall. In this way, most likely, the name Snow Plant originated. A near relative is the **Pine Drops** (*Pterospora andromedea*), a red-brown plant with a slender stem one to two feet high which is commonly found beneath the Yellow Pines.

One of the great rarities of this region is a species of **Lewisia** (*Lewisia yosemitiana*) which grows in the granite sand on top of the domes about Yosemite and nowhere else in the world. The white flowers rise from underground roots and open out on the sand like stars set in the very crowns of the domes. These plants are very delicate as well as very rare and should never be disturbed, since they will fall to pieces in one's hand if dug up from the place where they grow, as if in resentment at man's interference with them. They, however, are well worth seeking for field study by lovers of rare plant life.

In dry open swales of the great Yellow Pine Forest one comes upon the tall stalks (four to six feet high) of a great white lily bearing sometimes ten or fifteen flowers, which now is called the **Washington Lily** (*Lilium Washingtonianum*) although that pioneer botanist, Dr. Kellogg, distinctly named it the Lady Washington Lily, after Martha Washington, the first lady of the land, as he said.

On sandy pine barrens great areas may be crimsoned with little **Mimulus** (*M. torreyi* and *M. bolanderi*). Here also **Pussy's Paws** (*Calyptridium umbellatum*) often add to the pink or red carpet of the forest floor. The stems radiate from a central rosette of leaves which lie flat on the ground and bear at the ends an involved soft mass of flowers, forming a cluster which whitens with age and suggests the common name by which the plant is known. In sunny spots the tall scarlet **Gilia** (*G. aggregata*) form brilliant patches which greatly attract the humming-birds in their search for hidden sweets. Its corollas are tubular and about an inch and a half long, the exerted stamens inserted in the notches between the lanceolate lobes. Still other areas are blue with other *Gilias* such as *G. leptalea*, the flowers of which are about one half inch long.

On granite sand spaces one may find many acres covered with **Golden Stars** (*Brodiaea aurea*), a species of *Brodiaea* which is related to the blue Grass Nuts of the foothills. In the forest one meets the **Nuttall Mariposa Lily** (*Calochortus Nuttallii*), its almost white flowers bearing an inky spot about the gland at the base of the petals. At slightly higher altitudes may be found the tiny **Sierra Pussy's Ears** (*Calochortus nudus*) with its small white hairy petals.

Sandy areas will often be clouded by the delicate

little white flowered **Eriogonum** (*E. spergulinum*). It is a dainty little annual with small white flowers borne on hairlike stalks which give it a very airy and fragile appearance. It has somewhat the appearance of the Baby's Breath of our gardens and is in places so abundant that it forms a great Milky Way through the forest which is as beautiful by moonlight as by day. Another delicate white flowering herb with a diffusely branching flower cluster is the **Silver Tails** (*Potentilla santolinoides*). This may be easily recognized by its peculiar caterpillar-like leaves which form a silvery rosette at the base.

Rocky or gravelly slopes are often resplendent with lovely hanging gardens of **Pride of the Mountains** (*Pentstemon menziesii*). This brave plant grows in the most unhospitable places but develops into a tall and bushy plant with ovate finely toothed leaves and beautiful trumpet-shaped flowers which are reddish in color. Wherever this *Pentstemon* appears it is indeed the Pride of the Mountains, blooming profusely as it does in the midst of rocky barrens.

The high mountain meadows above Yosemite are frequently wonderful wild gardens. In one of those meadows it was once the author's good fortune to see fully twenty thousand plants of the **Jeffrey Shooting Stars** (*Dodecatheon Jeffreyi*) in full bloom. This is a plant which resembles the Cyclamen of our gardens. Among the Shooting Stars one often finds the feathery white flowers of **Polygonum** (*P. bistortoides*); the slender stems are very erect and bear at the summit a close mass of small white flowers which at a distance look like neat white flags. A meadow full of Shooting Stars and this white *Polygonum* has the appearance of a fresh and orderly mountain garden. The stream

which usually meanders through these rich meadows is often lined with clumps of the **Labrador Tea** (*Ledum glandulosum*). This is an evergreen shrub with shiny oval leaves which, due to the resin which they contain, are peculiarly fragrant when crushed. The white flowers are grouped at the ends of the branches in flat-topped clusters. By the stream bed one may often find lovely robust plants of the large **Pink Monkey Flower** (*Mimulus Lewisii*) which replaces the scarlet species of the Yosemite and lower valleys. The flowers are showy, light pink, and plainly two-lipped but the two lips are similar. In these swamps grow the quaint **Elephant Heads** (*Pedicularis attollens*) with its slender rose-pink spikes. The name Elephant Heads arises from the peculiar corolla with its hooded upper lip prolonged into a curved beak or proboscis. Associated with the foregoing one finds the blue **Pentstemon** (*P. confertus*) which is not so tall nor so many flowered as that at lower altitudes. Often a marshy stretch may be covered with the pale creamy cups of the **Marsh Marigold** (*Caltha biflora*).

The different meadows often vary greatly in their plant composition. On the one hand one may see meadows filled with flowers which grow higher than the waist and so thickly that it is impossible to step without treading down many plants. There are **Rein Orchis** (*Habenaria unalaschensis*) with long tresses of small white flowers; many species of **Lupins**, the largest and most attractive of which bears great masses of showy blue spikes (*Lupinus longipes*); the great yellow **Cone flower** (*Rudbeckia californica*) standing shoulder high and ending in a single conical head; the purple **Fireweed** (*Epilobium angustifolium*) which raises its long wands to the breeze; and the curious



PLATE XXVI

The Snow Plant (*Sarcodes sanguines*)

This remarkable plant, which is entirely fire-red, is one of the most curious species in the Park

Photo by A. C. Pillsbury

Corn Lily (*Veratrum californicum*) which adds its characteristic large-leafed clumps and stout cornlike stems to the meadow population, recalling in its appearance the Eastern False Hellebore. Instead of these rank growing meadows one may see a close carpet of green painted here and there with brilliant patches of crimson, gold, and pale lavender. The crimson on closer observation proves to be the bright crimson **Paint Brush** (*Castilleja Culbertsonii*), the gold a **Potentilla** (*P. gordonii*), and the lavender the **Mountain Daisy** (*Erigeron compositus*).

A common shrub at altitudes of five thousand to eight thousand feet is the **Green Manzanita** (*Arctostaphylos patula*). The stems of this manzanita are three to six feet high and much branched so as to make a spreading shrub. The leaves are very green and fresh looking and the bell-shaped flowers deep pink and in compact terminal clusters. More or less associated with it at the higher altitudes one finds the **Bitter Cherry** (*Prunus emarginata*), its crimson cherries most attractive to the eye in August but shocking to the taste. It forms dense thickets on moist slopes and is often quite abundant.

Throughout the Yosemite region one is impressed with the number of species of **Eriogonum**. One of these which is not uncommon between five thousand and seven thousand feet is the **Sulphur Flower** (*Eriogonum umbellatum*), noticeable for the spots of yellow which it lays upon many a stony slope or rocky crag. On Lambert's Dome one will find another kind, **Lobb's Eriogonum** (*E. Lobbii*) whose white flowers are much larger and, since the stem reclines upon the granite rock upon which the plant grows, it seems as if they weighed down the stalk which bears them.

At the high altitudes, generally from 7500 to 9000 feet, there appears the **Snow Brush** (*Ceanothus cordulatus*). This is a low flat-topped shrub which forms circular mounds five to ten or fifteen feet broad and commonly one to three feet high with olive or grayish branches and rigid or often spinelike twigs. Its low compact growth is the result of the heavy burden of snow that it must carry for several months of the year. In the summer it also carries a white burden, but this time it is light and fragrant instead of heavy and cold. Whether it is the abundance of white bloom in the summer or the snow of the winter which causes this species to be called Snow Brush is disputed, but its distinct habit and abundant occurrence at higher altitudes always focuses the attention of the mountaineer.

The swampy alpine meadows of the Hudsonian Zone (at about 9000 to 10,000 feet) often possess an interesting inhabitant of the Heath Family. The little **Kalmia** (*K. polifolia* var. *microphylla*) with its curious pink bloom carrying the anthers in pockets of the corolla, is always a quest with the climbers who know rare plants. If one watch these meadows carefully he will see the tiny pink or white bells of the **Dwarf Bilberry** (*Vaccinium cæspitosum*) close against the ground. On gentle slopes moist with seepage water from the snow banks above, one finds the **Snow Fairies** (*Lewisia pygmæa*), tiny plants with a few white star flowers. Two other diminutive shrubs of the Heath Family also grow at these high altitudes. The **Red Heather** (*Bryanthus Breweri*) has stems densely clothed with linear leaves and ending in a cluster of red flowers with conspicuous darker red stamens; it has the greater altitudinal range of the two heathers and is

often quite abundant. The **White Heather Bell** (*Cassiope Mertensiana*) is usually found with the Red Heather at the higher altitudes; it grows in heavy masses along the Lyell Fork of the Tuolumne and picturesquely decorates the margins of most high mountain lakes.

As the traveler climbs the high ridges and peaks and passes upward beyond the limit of trees he is conscious that he is approaching the limits of life for both plants and animals. In consequence, his interest is intensified in those plants which occupy the frontiers of the earth's vegetation and typify the Boreal Zone. Due to the high actinic quality of the light, most of these plants possess intensely pure or delicate colors and tell the climber that he has reached a world different from that at lower altitudes. In their reproductive season these flowers appear very fragile and seem in strange contrast to their harsh and wild surroundings. If closely examined, however, it will be found that the permanent portion of the plant body is extremely condensed at or below the surface of the ground and is well fitted for the long arctic winter and the daily changes in temperature from freezing to summer mildness which occur even in July and August at 9500 to 13,000 feet.

Those alpine plants which are extremely condensed and developed laterally are technically characterized as "cushion plants." In this form of plant body the stems branch and rebranch, forming with the leaves a closely interlaced cushion-like vegetative body resting on the ground. From this surface the flower stalks arise. The **Alpine Eriogonum** (*E. incanum*) illustrates this high montane vegetative habit as does also the little golden **Draba** (*D. Lemmoni*), its leaves

forming close rosettes at the base and its bright yellow flowers with the petals in fours. One of the most handsome of these plants is the **Alpine Phlox** (*P. Douglasii*), its cushion covered with white flowers, long to be remembered as a thing of beauty. Two alpine **Erigerons**, dwarfs with daisy-like flowers, inhabit the highest peaks. *E. compositus* has leaves toothed or lobed at the apex, while those of *E. ursinus* are entire.

The second type of alpine plant is frequently much dwarfed but does not develop the body laterally into a distinct smooth cushion. Like the cushion plants they often have, however, most delicate or showy flowers. One of the most glorious of these high mountain species is the **Yellow Columbine** (*Aquilegia pubescens*), a lovely graceful plant to which the wild grandeur of its rocky surroundings is an almost dramatic foil. It grows on high ridges at about eight thousand to ten thousand feet and has large and handsome flowers which run through a considerable gamut of colors from yellow, white, or cream to pink or lavender. It is a very aristocrat among the Columbines, quite different from the modest red-flowered sort which grows in the Valley. This latter is the same as the common **Columbine** (*Aquilegia truncata*) of the Coast Ranges.

Between eleven thousand and thirteen thousand feet one finds the **Alpine Buttercup** (*Ranunculus oxynotus*) which, in a modified form, extends northward through Oregon, Washington, and British Columbia to Alaska and as far as the Bering Sea where it is found almost at sea-level. It is a characteristic Buttercup with deep golden yellow corolla, the only one of its genus in the alpine Sierra. Another true



Shooting Star
(*Dodecatheon Jeffreyi*)

PLATE XXVII
Bleeding Heart
(*Dicentra formosa*)

Photos by A. C. Pillsbury

Elephant Heads
(*Pedicularis attollens*)

alpine inhabitant is the **Sierra Hulsea** (*H. algida*), a sturdy but small sunflower-like plant three to six inches high with more or less white woolly leaves and stems. The bright blue trumpets of *Pentstemon menziesii* var. *davidsonii* are truly remarkable for the pure tone of the intensely blue corollas. A Stone-crop, the **Alpine Sedum** (*S. roseum*) inhabits the alpine rocks and forms matlike clusters of fleshy leaves and pinkish flowers.

Much sought by mountaineers is the **Sierra Primrose** (*Primula suffrutescens*), a handsome but small red-flowered plant with very shiny, toothed leaves which grows on the rockiest and highest peaks. Equaling it in interest are the sky-blue **Polemoniums** (*P. eximium*) which are sometimes called **Sky Pilots**, their petioles crowded with tiny leaf segments and the stems ending in dense clusters of lovely blue flowers which defy the barrenness of their surroundings. Little **Alpine Willow** trees an inch high (*Salix tenera*) further testify to the arctic character of the highest Sierran peaks. On these same peaks grows the **Alpine Sorrel** (*Oxyria digyna*), an interesting little plant of rock crevices with pinkish insignificant flowers and roundish cordate leaves.

The **Steer's Head** (*Dicentra uniflora*) is another reward to the alpine climber to such high places as Mount Dana, Macomb Ridge, and Tower Peak. Its delicate blossoms borne on slender naked stems two or three inches high, come up at the edge of snow banks and sometimes in crevasses of snow near the margins of bowlders. The flowers are of very singular construction, the lateral sepals spread out in such a way as to answer to the horns of a steer; the two inner petals are so constructed as to form the snout, and the

inner sepals or forelocks point to the eyes, which are furnished by the shoulders of the petals. These flowers hang on their stems in such a manner as to suggest drowsy cattle, their heads cocked a bit as if half disturbed by an intruder and mildly surprised. Its singular appearance and its rarity give this plant a unique interest, to which may be added the observation that perhaps no other species of our alpine flora is so typically a relic of preglacial times.

The flora of the Sierra Nevada comprises one of the most marked and distinct units of vegetation of the earth's surface. The Yosemite area is thoroughly typical of it, and not elsewhere on the Sierra chain can a transection of it be studied to better advantage than here. All the flowering formations are remarkable, and each in its best seasons has its own peculiar interests. This fact is singularly true because primitive conditions prevail over most of the area, and even in the foothills undisturbed plant societies may still be found by the explorer; while within the park limits the native plant life still reflects the old-time glory of the natural gardens of the Sierras.

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CAMPING AND MOUNTAINEERING



IN
**YOSEMITE
NATIONAL
PARK**

By

RAYMOND H. BAILEY

Manager of the
Camping Tours Department
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CAMPING AND MOUNTAINEERING IN YOSEMITE NATIONAL PARK

BY RAYMOND H. BAILEY

*Manager of the Camping Tours Department, Yosemite
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FEW of us indeed are so well adapted to modern conditions of living that Nature's call to play Gypsy a while finds no response. There comes a longing to revert to the natural ways of living our early ancestors enjoyed, and to throw off for a time some of the shackles with which civilization has bound us.

Pure, cold, sparkling water, not from a pipe, but from a mountain spring; the murmur and fragrance of the breeze among the pines and fir trees; and the song of birds and the call of the wild creatures of the forest, grip the imagination and are woven in with a desire for recreation and relaxation. Thus a wish is born for a taste of simple living out in the open, away from the haunts of man and free from cares and responsibility.

This wish is quite universal. It finds expression in "Weary Willie" with his tomato can boiling over a cheery fire beside the railroad track, living off the land as he goes. But it also exists in high places. While the rest of the Belgian royal party stopped at the hotel but a few miles distant, Prince Leopold chose to camp out beside Bridalveil Creek, spending the night in a sleeping-bag beneath the pines, gathering firewood, and eating flap-jacks in such numbers as only a grow-

ing boy can encompass. Even the apartment dweller, bored with the daily drudgery of the compact and convenient kitchenette, finds delight in her culinary duties as she cooks such delectable dainties as fish, bacon, and browned pancakes over an open fire; and one unaccustomed to the simplest duties at home discovers pleasure in service and the self-reliance which comes with each new task learned while camping.

It is doubtful if there can be found another spot on earth with so many conditions favorable to camping out in the open as are found in the Yosemite National Park and other near-by regions in the Sierra Nevada Mountains. This is where John Muir spent so much of his time, and of which he wrote so beautifully, and after all his world-wide travel he declared that he still loved it the best.

The weather is ideal for camping in the summer and fall—pleasantly warm during the day without being hot, the nights ranging from cool to cold according to the altitude. Day after day is clear, without a cloud in the sky, and the heavens are marvelously bright at night. The freedom from rain is one of the most delightful features, there being no storms for weeks at a time. When they *do* occur they are usually brief afternoon thunder showers, recurring perhaps for two or three days. Except for a large piece of waterproof canvas for an emergency, little or no provision need be made by the camper against rain; the use of tents for shelter in this region are the exception rather than the rule.

Annoying flies, insects, and other pests are practically unknown with the exception of mosquitoes, which are troublesome in some places only for a short

time after the snow has melted from the ground, leaving temporary pools of water in hollows. But even mosquitoes are usually lacking or can be avoided in choosing a camp site.

The air is invigorating, and water, abundant everywhere, is crystal clear and icy cold. The many mountain streams and lakes throughout the park, teeming with trout, make a fisherman's paradise.

Virgin forests of pine, fir, cedar, and scores of other species, dotted with flower carpeted meadows, extend to the slopes of the rugged snow-capped peaks which beckon to those below to come upward and enjoy the magnificence of the views they command.

Only a very small portion of the park is accessible to the tourist stopping at the hotels and lodges in the Yosemite Valley and its immediate vicinity. But the whole park is open to the camper, inviting him to leave the beaten paths and to explore regions seldom visited, to view beauty and grandeur in solitude, to fish where no other fisherman has just preceded him, and to enjoy the pleasures of camping in lovely spots at will, without schedule, and without a thought of the outside world which seems so far removed.

The Camping Season

The season well suited to camping on the floor of the Yosemite Valley, which is at an elevation of about four thousand feet, usually extends from May to October, inclusive. April and November are often delightful, but provision should be made for occasional storms and cold weather. In other portions of the park the camping period is shorter, depending upon the amount of snow on the ground, which, in turn, is dependent

largely upon the altitude—July, August, and September being the best months.

During the first of the season there is the greater volume of water which is advantageous for its scenic value but sometimes undesirable for the best traveling and fishing in the higher sections. Wild flowers are in their prime somewhere during all the season, at increasing elevations as the months progress. In fall the coloring is beautiful, the air is crisp and invigorating, and the number of visitors is small. July is the month of greatest travel.

Where to Camp

The Yosemite National Park is one large camping ground. Wherever there is wood and water, and feed if there is stock, there is a potential camp. Trails lead to all parts of the park, and it is a poor trail indeed which does not pass at least one good camping spot every hour or two. Auto roads are fewer but afford many camp sites, especially the Tioga Road, which passes Lake Tenaya, through Tuolumne Meadows, and over Tioga Pass, connecting with the roads to Lake Tahoe on the north and to Los Angeles by way of Owen's Lake to the south.

The choice of a camping place or camping itinerary is largely a matter of the objectives sought and the time at one's disposal. If mountain climbing and high alpine scenery is desired, the crest of the High Sierra forming the easterly boundary of the park will afford the best in this line. There is hardly a section where excellent trout fishing is not to be had, but the best near-by points are to the east and northeast of Yosemite Valley, and it is still better farther north where it is less frequented.

As a fixed camp or auto camp, Tuolumne Meadows is unusually well located, there being innumerable lakes, streams, waterfalls, peaks, and varied points of interest within a day's walking distance. Rodgers Lake is probably the gem of the park, and is noted for its splendid fishing as are also Benson Lake and Matterhorn Creek, near by.

The Northerly portion of the park is least frequented because farthest from the Valley, but it is rugged and interesting, and well worth while for the one who has three or four weeks to spend.

How to Go

There are about as many gradations in the manner of camping as there are campers. At one extreme are those who would go light like John Muir, for days with but some tea and a few crusts of bread, or like another mountaineer whose only excess clothing was a single sock, that each of his hard-worked feet might have a change of raiment on alternate days. Then there is the "Tin Lizzie," with parents in the front seat and bulging with progeny in the rear, the back and sides packed and draped with every conceivable household article, *Lares et Penates* and all, until the identity of the conveyance is completely concealed except for the rattle. The student with a month's growth toward his first beard, traveling with a donkey, Stevenson fashion, and the luxurious limousine parked beside the Tuolumne River are equally in keeping as types of camping to be found.

The stationary or fixed camp appeals to those whose desire is to be settled in some beautiful spot, to rest, or use the camp as a base for excursions to near-by points of interest. As the transportation of equipment and

supplies is simplest on this kind of an outing, the amount of comfort and luxury which may be indulged in is a matter of personal taste. In the Yosemite Valley, beside the Merced River, are a number of camping places, some for autoists, and others for those without machines, prepared by the Government with piped water and sanitation provisions, and assigned to campers at the office of the Park Superintendent. The Tuolumne Meadows are also particularly well suited to camping in a fixed spot for those who wish to loaf or fish or to make side trips to the many near-by points of interest.

But in order to see much of the park it is necessary to move camp from place to place. The most independent and least expensive means of travel is afoot, carrying the total camping equipment and provisions on the back. This is enjoyable for good walkers with strong backs, but should not be attempted by any not wishing strenuous, hard work. Those carrying their own loads should observe the Rule of I. O. U.—Inches, Ounces, and Utility—discarding all but the real necessities, for a pack which feels light in the morning grows very heavy before the day's tramp is done, and robs such a trip of much of its pleasure.

Many enjoy walking on the trails who do not wish to be burdened with carrying their outfits. Burros and pack mules may be used for this purpose. Only animals accustomed to mountain trails and broken to packing should be taken, as other animals are likely to prove useless, if not dangerous, on the trails. If there are but one or two pack animals it is usually advisable to tether them out with long ropes so as to keep them from wandering away from camp. The best

stand of grass should be selected, as free from trees and snags as possible, and the animals shifted to new locations at frequent intervals, as it takes considerable green feed to keep a working animal in condition. If there are several animals, it is customary to hobble a mare, or one or more of the more adventuresome animals, and place bells on others to help locate the band. Grain need not be taken for the animals if care be exercised in selecting camps where the food is good, but a little grain fed the first morning or two is often helpful in keeping the stock near camp.

About every second or third year the park is visited for its annual outing by the Sierra Club, a conservation and mountaineering organization which has taken a leading part in the preservation of the forests and other natural features of the Sierra Nevada Mountains and in the development of National Parks. Approximately for the whole month of July, about two hundred of its members and friends walk from camp to camp, some ten to fifteen miles a day, the commissary and transportation of the entire outfit being provided by the organization. This is a delightful way of camping in the park, inexpensively and relieved of all cooking and packing.

Riding horseback, with pack animals to transport the outfit over the trails, is still another way of camping out, and a most delightful way of getting about the park with the greatest amount of comfort. Care should be exercised to take only saddle animals and pack animals which are accustomed to mountain trails, and double cinch saddles are advisable. If it is desired to lighten the work of such a trip, this can be done by engaging a guide, packer, or cook, or the whole trip may be arranged, outfitted, and conducted

by the Camping Tours Department of the Yosemite National Park Co., which also conducts certain definitely scheduled camping trips which anyone may join.

Automobile camping is becoming very popular, and when the new highway is completed into Yosemite Valley will undoubtedly increase very greatly. But as yet it should be understood that although the roads are very good of their kind, still they are mountain roads, steep and rough in places. They are safe for careful driving and for machines which are in good running order. Brakes should be in first class condition, and two spare tires are advisable. The motor trip from Yosemite to Lake Tahoe by way of the Tioga Road and the Leevining Creek Grade is particularly fine, and there are good camping places along the route.

What to Take

The question of what to take and what not to take on a camping trip is a most important one. To be without real necessities can prove very annoying, but to be burdened with a lot of unnecessary things very often mars the comfort and pleasure of a trip. It is well to take just as little as is consistent with comfort, but that little just right, keeping in mind that it is the general tendency to take entirely too much in a desire to play safe. If the means of transportation be knapsacking, the load of necessity must be cut to a minimum, whereas it can be materially increased if carried by pack-train or automobile.

There are a number of good books on the subject of camping which deal in minute detail with such subjects as clothing, personal effects, camping equipment,

packing-outfits, cooking utensils, provisions, cooking, selection of camp sites, etc., which will prove quite helpful to a camper. No attempt will be made here to cover these subjects in detail, but a few suggestions as to some items, particularly as related to conditions in this park, may be of service. Since there are so many types of camping, and as no two experienced campers will agree on many details regarding camping, each prospective camper will have to judge of the applicability of the following suggestions to the particular conditions of the trip contemplated.

Clothing should be durable, of medium warmth, and comfortably large. The following list is suggested as suitable for a month's outing:

- 2 suits medium weight underwear
- 2 woolen and 1 cotton shirt (or waists)
- 6 prs. socks or stockings (medium to heavy)
- 1 outing suit or old business suit
- 1 extra pair trousers, riding breeches, or skirt of khaki, corduroy, or whipcord
- 1 sweater
- 1 pair stout walking shoes with puttees or leggings (or light boots, if preferred)
- 1 pr. comfortable light shoes for camp
- 1 pr. gloves or gauntlets
- 1 soft felt or cloth hat with fairly wide brim
- 2 bandannas and 3 khaki handkerchiefs
- 1 pr. flannelette pajamas

For riding or hiking, riding breeches are most commonly worn by women, or riding habits if much time is to be spent in the saddle. Short skirts, however, but a few inches below the knee, and worn with shorter knickerbockers of the same color, are suitable for general wear if preferred.

Special care should be taken to have comfortable, good-fitting shoes, and it is well if possible to break them in before starting on a trip. Shoes with broad toes and low, flat heels, of the Munson type of last, with soles heavy enough for cone-headed Hungarian nails, are good for trail work and mountain climbing. But avoid crowding the soles with nails, as too many result in a poorer grip than none at all; and there should be no nails in the shoes for riding. If shoes a half size larger than usual are worn with two pairs of socks, one medium cotton and one heavy woolen pair, friction is reduced, and there is less danger of blisters. When the feet become toughened, if two pairs of socks prove uncomfortably warm, one may be discarded by using cork inner soles.

Heavy, high boots are to be avoided if much walking or climbing is to be done, but stout-soled, light-topped, ten- or twelve-inch boots, just high enough to hold the trouser legs, are particularly good. Appearance is sacrificed, but greater freedom of movement is obtained than with high boots or with riding breeches, shoes, and puttees.

Basket-ball or similar shoes with heavy rubber soles are good for smooth rock surfaces, comfortable for camp use, and are used almost exclusively by some hikers for all-around service.

As ordinary shoe laces wear out quickly on walking trips, it is well to take an extra pair, or better still, some buckskin laces. If ice work is to be encountered, a set of baseball cleats screwed to the soles of walking shoes is good, but unless this kind of climbing is particularly sought on some of the glaciers, there is no need of them in this park.

Although generally there is very little use for a rain-

coat, a very light weight one is occasionally handy in the event of a storm, and a bathing-suit is also convenient on occasion.

Personal effects are likely to become burdensome unless care is taken to eliminate all but the truly useful ones. A very few toilet articles will suffice. Watch, knife, and compass are very useful, and one should never be out in the mountains without a map and matches. With the one there is very little likelihood of becoming lost, and with the other comparative comfort may be enjoyed even if caught out over night. Many a person has experienced inconvenience, anxiety, and discomfort, if not danger, because of trusting to someone else to carry these very necessary articles.

An excellent Topographic Map of Yosemite National Park is published by the U. S. Geological Survey, and may be obtained by remitting 25 cents by money order or cash to the Director of the United States Geological Survey, Washington, D. C. The map is $28\frac{1}{2}$ by 27 inches; the scale approximately 2 miles to the inch; and the roads, trails, and names are printed in black, the streams and lakes in blue, and the relief in brown, indicated by contour lines representing 100-foot intervals. This same map, folded and bound between paper covers, may be obtained by remitting 40 cents. It will not stand a great deal of usage without tearing along the creases, but the flat map selling for 25 cents may be mounted in durable form convenient for carrying in the pocket by cutting it into sections along the lines indicating each 10 minutes in latitude and longitude, and pasting these sections $\frac{1}{4}$ inch apart on muslin of a little closer weave than cheesecloth.

The U. S. Geological Survey also publishes a Map of

Yosemite Valley, 35 x 15½ inches, scale 2000 feet to the inch, with 50-foot contour intervals, which will be mailed upon remittance of 10 cents in coin. This is a splendid large-scale map of Yosemite Valley and its immediate vicinity, but does not cover the rest of the park.

These maps may also be purchased in Yosemite (by personal application, but not by mail) at the office of the Superintendent of the park or at the general merchandise store.

Tinted glasses are often useful for relieving the eyes from the glare of the sun on the rocks, and quite indispensable on glaciers or large snow fields. A pedometer, adjusted to the length of one's step, is good for approximating the distance traveled in walking. A small electric flashlight or the smallest size acetelene camp light or some type of folding candle lantern comes in very handy at times. If mosquitoes should be encountered, a bar of mosquito netting or a small vial of oil of citronella (repellent) might not come amiss. Stout twine is often in demand.

Adhesive tape rivals the safety-pin as "handy man" about camp. By applying it to the portion of the foot where soreness first begins to manifest itself, a blister usually can be avoided, and it is good for holding gauze or wrappings in place. Tape may be used to secure the cover on an opened can, seal the holes in a can of milk, patch a cracked watch crystal, effect hasty repairs to clothing, and accomplish many original acts which readily suggest themselves.

Take no fire-arms, as hunting is prohibited in the park, but be prepared with finishing tackle, for trout are plentiful. California Royal Coachman, and Gray and Brown Hackle flies with peacock body, are univer-

sally good, and many others do well according to the local conditions. Numbers eight and ten are the sizes generally used. The necessary State Fishing License may be secured in Yosemite. The daily catch of trout is limited to twenty fish, providing, however, that in no event may more be caught than are to be used.

It is hardly necessary to suggest a camera and an ample supply of films for a trip into a region of such beauty and magnificence.

Sleeping equipment is a most important consideration, since about a third of one's time is spent in bed. The type of bedding is largely a matter of choice, but as experienced campers differ materially as to the best, more than one will be mentioned. All bedding material is best if dark in color, so as not to show the dirt. Three wool blankets of about five pounds each are ample for cold nights in the higher altitudes, and two are sufficient for usual needs. A 10-ounce canvas about seven feet square when folded will serve as a ground cloth and also an extra covering. If the blankets are folded lengthwise and sewed along the bottom and side, or fastened with large safety pins or small blanket pins, this sleeping-bag will give greater warmth and comfort. The canvas may also be made into a bag.

The following quotation from an Outing Announcement of the Sierra Club describes a lighter weight sleeping outfit recommended for use in this region: "This should consist of a sleeping-bag made by doubling two wool comforts, so as to give the bag the greatest length, and sewing securely across the bottom and two thirds of the way up the side. This bag should be lined and covered with gingham or sateen, which should project a foot or two beyond the top as a loose

flap. The wool comforters may be sewed up into separate bags as indicated, and one lined and the other covered. One bag can then be slipped inside the other for ordinary use and removed easily for knapsack trips where economy of weight is desirable. A tall person will require extra length comforters. Blankets are too heavy and cotton comforts are not desirable. A waterproof sheet or covering at least six by six feet should be taken. Canvas and the ordinary rubber blanket are entirely too heavy for this purpose. The most serviceable and satisfactory material is waterproof silk (balloon silk). It is strong, durable, perfectly waterproof, and very light. A piece five yards in length, cut in half and sewed together along one side, will make a large sheet that will protect the sleeping-bag from the ground and form a covering as well."

One thick lamb's wool batting comforter is lighter and has about the same warmth as two ordinary wool comforters, and an eiderdown quilt is still lighter for the same amount of warmth but not so serviceable. If a sleeping-bag is used it should be so made that it is capable of being aired easily. Should the bedding prove inadequate for the coldest nights, a hot-water bottle, heated rock, a pair of soft woolen bed socks will probably solve the difficulty by keeping the feet warm. A small down cushion makes a very light but comfortable pillow. Air cushions are less comfortable but more convenient.

Suitable packing equipment adds to the comfort and convenience of a camping trip. A hiker's whole outfit may be rolled up inside sleeping-blankets and carried over one shoulder, but it is preferable to use a pack-sack or pack-harness for greater convenience and comfort, and in order to secure a better distribution

of the load; this permits of the use of a light-weight sleeping-bag which is much warmer for its weight than blankets. Even for carrying lunch and other light articles on the trail, a small knapsack or rucksack with straps over both shoulders is much more comfortable and permits greater freedom in walking than a bag carried on but one shoulder.

In packing animals, the use of coal-oil boxes (the cases in which two five-gallon cans are shipped) slipped into kyacks or strapped in canvas slings, greatly facilitates the packing of provisions or equipment without danger of injury from pressure of the pack ropes. Dunnage bags of stout canvas three feet long and eighteen inches in diameter (when packed) are very convenient for packing sleeping equipment and personal effects.

A pocket roll is most useful in packing and carrying one's effects. Again quoting from the Sierra Club's Outing Announcement, a description for a pocket roll follows: "It should be made of denim or drilling, as follows: A piece three feet square is first taken as a back, and three box-plaited pockets, each of a foot deep, and one above the other and extending the entire width, are securely sewed to the back and bound with tape. The upper pocket can be divided into three divisions to hold small articles. All these pockets can be closed with flaps or tied with tapes. Into this roll all one's belongings except bedding can be packed, and it can be arranged with eyelet and cord, and hung to a tree when in camp."

As cooking utensils are bulky and hard to pack at best, care should be taken to have them of convenient shape and size, and nesting one inside the other as far as possible. Some of the kettles at least, should be of

granite or enamel ware, so as to render them safe against acid while cooking or holding certain fruits or vegetables. Tight-clamped covers for these kettles will make it possible to carry such foods from one camp to another. Nesting ten- or twelve-inch galvanized buckets are handy for cold water, hot water, and dishpan. Be sure there is an extra can opener.

Fireless cooker, Dutch oven or folding reflecting oven, shovel, and axe, are all good if consistent with the means of transportation, but none are necessities. Some type of folding stove, grate, or fire irons is very convenient, and a great time-saver when shifting camp often. Two iron bars $\frac{1}{4}$ inch by 1 inch by 3 feet long, having riveted to each end folding legs of the same material 15 inches long, pointed at the ends, make a very good set of fire irons when driven into the ground about 5 inches apart at one end to hold the smaller cooking utensils, and about 8 inches at the other end for the larger ones.

Provisions should not as a rule include many canned goods containing a large percentage of water unless the transportation is a minor consideration. Dried fruits and vegetables go much farther for their weight and bulk. It is well to plan for variety in the diet, as this can be done with a little thought without increasing the weight or expense. Small cloth bags are good for packing broken package- or bulk-goods, for paper sacks will soon go to pieces.

On a camping trip one craves sweets and fats much more than normally. One quarter pound per day per person is about the average amount of sugar used. Jams and jellies and an abundance of dried fruits go well. Bacon is the regular stand-by, and ham comes next. An average use of bacon and ham (principally

bacon) is about one fourth to one third pound per day per person if used freely. If the grease is saved for frying fish and hot cakes, making gravies, etc., little lard or other fats need be taken for shortening and cooking. Hot cereals for breakfast and tea as a beverage are generally liked, even by those who seldom care for them at home. Beef extract, bouillon cubes, and powdered soup are convenient as soup stocks.

Butter as now packed in convenient one-pound tins cannot be distinguished from the fresh, and there is now some very successful powdered milk in grades from skimmed milk to cream. While not quite so instantaneously available for use as canned milk, it is much lighter and less bulky, and is generally preferred to canned milk because of a more natural flavor.

About five pounds per day per person is considered a normal allowance of provisions if they include those which are watery and bulky, while just about half that amount is sufficient if the foods are all concentrated such as would be suitable for a knapsack trip.

What can be Supplied in Yosemite

A tourist or "dude," as more frequently designated by the guides and packers, may come to Yosemite with never a thought of camping out and, if the notion suddenly appeals to him, either purchase or rent everything essential for a comfortable camping trip. The Yosemite National Park Co., operating under concession from the Government, conducts several departments which will be of service to a camper, and all rates and prices will be found reasonable, being controlled and authorized by the Government.

The General Merchandise Store carries a good line

of outing clothes and shoes suitable for camping, cooking utensils, supplies, and a large stock of provisions. It has on sale the folded map of Yosemite National Park previously mentioned, fishing tackle, and the necessary State Fishing License. A limited stock of provisions may be obtained from some of the lodges in the park outside of the Valley.

The Housekeeping Department can supply a party of any number of persons with a full camping outfit including tent, bedding, furniture, cooking utensils, etc., for a fixed camp in Yosemite Valley, set up ready for housekeeping.

The Camping Tours Department serves those who wish to move from place to place while camping out. Guides, packers, cooks, saddle-animals, pack-animals, and packing and camping equipment can be furnished those wishing to manage their own camping trips. All-Expense Camping Tours at a fixed daily rate per person are planned, arranged, and conducted for parties desiring exclusive service for saddle trips independent of schedules, but wishing to be relieved of all personal responsibility of management and to be able to start on the trail carefree and without loss of time. All riding and packing stock, attendants, sleeping and cooking equipment, and provisions, are included in the charge—in fact everything necessary for a complete and comfortable camping trip except one's clothing and personal belongings. A number of definitely scheduled All-Expense Camping Tours of from two days to two or three weeks are organized and conducted during the summer for any individuals who may wish to join such parties. A booklet telling of the trips and various activities of the Camping Tours Department may be secured from the Yose-

Yosemite National Park Company. Photographic supplies may be obtained at the numerous studios in the Valley. Yosemite is well able to equip an unprepared camper with all the necessities for a trip, but should there still remain some articles he may desire, they can be secured quickly and conveniently by parcels post.

There are a number of places in the park where one may secure information regarding camping. The National Park Service has an Information Bureau at the office of the Park Superintendent. The rangers in charge are well informed, maps of the park and Valley are on display and for sale, and the official booklet of General Information Regarding Yosemite National Park issued by the Department of the Interior is there for distribution. The Park Service also maintains a free Nature Guide Service with headquarters in the Government Administration Building in Yosemite. The transportation offices in the various hotels, lodges, and camps, are also prepared to impart information.

The Sierra Club maintains the LeConte Memorial Lodge in Yosemite Valley, and the Parsons Memorial Lodge in the Tuolumne Meadows, where maps and books pertaining to the park are available, and information may be obtained from those in charge. Rangers stationed at various points throughout the park can also be of assistance to campers, and their 'phones are available in case of need.

On the Trail

Before starting on the trail be sure that all fires have been carefully extinguished, and that the camp site has been left clean and inviting for the next camper. The value of an early start to get the most pleasure

out of a day's travel can hardly be overstated; if a long day's journey is to be made it is quite essential. But even for a short trip, traveling is at its best in the cool of the morning, stopping along the trail may then be indulged in without a sense of hurry, and an early camp can be made in time to fish, swim, loaf, or explore around camp during a part of the afternoon.

Whether walking or riding it is well to start out at an easy pace, increasing it gradually until muscles are limbered and breathing comes easily. Many have a tendency to tire themselves or their animals out during the first hour of travel by exhausting too much of their energy at the start. Endurance at a moderate gait throughout the day is what counts, rather than a speed which cannot be maintained. As a rule it will be found that it does not pay to take steep shortcuts on an up-grade; while saving a trifle in time at the moment as against the longer but easier grade, the additional effort and resulting exhaustion usually more than offset the temporary gain. Excessive drinking of the icy cold water of the mountain streams and lakes is to be avoided when one is hot, as it often brings on illness. Drinking small amounts at frequent intervals can be done with safety.

Most of the trails in the immediate vicinity of the Valley are very well made, and junction points are usually marked by sign boards. Farther into the mountains of the park, where there is less travel, not so much attention has been paid to easy grades or marking of junctions, but with the aid of the topographic map little difficulty is experienced in following any of them.

Except in occasional obscure places, trails in common use are clearly evident by the slight depression

worn in the ground. But sometimes in rocky places, meadows, or forests where the ground is thickly strewn with litter, or when the ground is covered with snow, the path underfoot is not distinguishable. To provide against such contingencies, trails are generally indicated by a continuous series of easily recognized marks within sight of each other.

In the forest, the marks are blazes on trees close to the trail, a blaze being a cut through the bark exposing a surface of the lighter colored sapwood. Blazes are cut in various shapes, many trails being marked by those having the form of the letter "T." In rocky places trails are usually indicated by several rocks piled one on top of the other, commonly known as "ducs," "monuments," or "cairns." In meadows, stakes or ducs are sometimes set along the trail if the trail is not marked where it leaves the meadow.

By referring occasionally to the Topographic Map of Yosemite National Park, which no camper should be without, the proper trails at junction points are easily ascertained; and if doubt exists at any time regarding a trail, it may be dispelled by checking its course with that of the trail indicated on the map. In this connection it may be well to make a few suggestions as to how to read this map, for those not accustomed to the use of a topographic map.

Names, roads, trails, boundary lines, etc., are shown in black, and lakes, rivers, creeks, etc., in blue, as on ordinary maps; but the brown figures and lines indicate elevations. Each brown line shows the contour of the land at its particular elevation above sea level, and the space between lines represents an interval of one hundred feet in elevation. At intervals of each five hundred feet above sea level is a heavy

brown line with figures every now and then showing its altitude. The elevation of any point may thus be determined by following the contour line passing through it, back to the nearest figures in the heavy brown line next below it in elevation, and then adding one hundred feet for each space separating these lines. The exact elevations of principal peaks, lakes, and other points of interest are also indicated by brown figures.

The spacing, position, and form of these brown lines tell at a glance the story of the topography of the country. If they are spaced far apart, the land between them slopes gently, while if they are close together a steep slope is indicated. The form the lines take and their relation to each other indicate the form and nature of the landscape. The size and shape of a mountain, ridge, spur, etc., are indicated, and the position shown as related to other features of the landscape and to the points of the compass. It will be noticed that a contour line in crossing a canyon forms an angle which invariably points upstream, thus indicating at a glance the direction in which the stream flows. A little study will reveal many such short-cuts for reading the features of the map rapidly, so that with a little use, the map will picture the country in relief at a glance.

Trails may then be left if one wishes to cut across country, as it is known in advance what will be encountered in the way of canyons, ridges, passes, etc. But it must be remembered that the map does not show the surface characteristics of the country. A steep mountain side which may be easy traveling if it affords good footing in a forest, may present difficulties if it proves to be a mass of broken rock, or may be

impassable if it is a smooth granite slope. For this reason it is usually inadvisable to attempt to take horses off the trail into unknown territory, but afoot one can usually find some way around most obstructions.

But before leaving a trail be sure that you have the points of the compass well in mind in relation to the direction in which you are to travel, so that if you should have any difficulty in retracing your steps, the map and compass may be brought to the rescue. In order to square the map accurately with the compass it must be borne in mind that the magnetic north is about sixteen degrees east of the true north in this park, so that while the north and south line of the compass should be parallel with the north and south line of the map, the magnetic needle should be pointing sixteen degrees east of north. With the map spread out horizontally and the top thus pointing accurately to the north, it is usually easy to find one's location at any time providing a view of some known object can be obtained. By sighting across the position of an object on the map to the object itself, a line is found passing through one's location, and the intersection of two such lines will definitely establish one's position on the map.

In Camp

If a comfortable trip is sought, try to make camp early enough to permit of some leisure without having to rush to prepare camp and get dinner before dark. In selecting a camp site a number of considerations enter in. Convenience to a sufficient supply of good wood and water perhaps come first. As no standing

timber, living branches, or shrubbery are allowed to be cut in the Park, dead wood must be depended upon entirely for fuel. For cooking purposes, limbs from one to two inches in diameter usually give best results, with smaller branches for kindling of quick, small fires. If such wood is not found on the ground it is often obtained by breaking the lower dead branches from living trees. This wood is dry even when that laying on the ground may be damp, and being usually brittle, it breaks readily into lengths by striking it against a rock, so that an axe is seldom necessary. An abundance of good feed should be near by for the animals.

Seek level, dry spots for sleeping quarters. The edge of a meadow, although apparently dry in the daytime, is likely to prove damp and cold at night, while a few steps distance into the forest or an elevation a few feet higher will generally secure a dry spot which will be many degrees warmer. Where pine needles are available, a pile of them spread out and used as a mattress will add greatly to the warmth and comfort of the bed. Should mosquitoes be encountered near a meadow, lake, or other spot where there is standing water, they can often be avoided by pitching camp a short distance away on higher ground or on a running stream. It is seldom necessary to seek shelter from wind unless camping in a draw or near a high mountain pass, but it is well to determine the prevailing direction of even a slight breeze so that the fire may be built where the smoke will blow away from camp rather than toward it. The location of the camp with relation to the fishing, view, mountain climbing, convenience for side trips, or such other objectives as may be sought, will readily suggest itself. A tent is

not often needed as shelter against storms, but is desired by some for convenience as a dressing room and place for storage. However, it is advisable to have a waterproof fly or canvas of some sort for use in case of rain, and each individual should have a waterproof covering of some kind for his bedding.

Too much emphasis cannot be laid on the necessity of selecting safe places for cooking fires or camp fires. The danger of causing a disastrous forest fire is constantly present unless every possible precaution for prevention is taken. Usually a sandy or gravelly spot is conveniently at hand, and if not, it often can be made by scraping away the surface covering of pine needles or leaves from an area several feet in diameter. But if the forest floor is thick and does not expose a surface free from roots or leaf-mold, it is unsafe, as a fire will often smolder in such material for hours or even days under the surface before coming to a blaze. A fire just large enough for one's wants requires the least fuel, is least likely to spread, and is the easiest to extinguish upon departure. If no camp stove or fire-irons are brought, flat rocks with straight edges often can be found, and quite a satisfactory fireplace may be built with parallel sides about six or eight inches apart and three or four feet long. A little piece of candle is often helpful in lighting a fire if small kindling is scarce or the wood is damp.

In frying trout more can be cooked in the pan if the heads are removed, and severing the backbone in several places will prevent a newly caught trout from curling up while cooking. As the heat necessary to boil water is approximately two degrees less for each one thousand feet above sea-level, boiled foods require considerably longer cooking at the higher altitudes.

Many canned foods being unsafe when allowed to stand in their tins after opening, it is a good rule to empty all tins of their contents as soon as opened.

It is advisable to make up one's bed before dark, and to gather enough wood for dinner and breakfast, putting a little kindling in some covered place if dampness during the night seems likely. Covering the food-stuffs will protect them from possible moisture and various small night-prowling animals as well as those which arise with the break of day. Occasionally leather goods such as shoes, straps, and saddles are damaged by small animals at night, unless they are hung up or otherwise put out of reach.

Before leaving camp a little house-cleaning is in order. Make sure that all tin cans, paper, and refuse have been buried or burned, that the water supply has been left clean and free from waste of any kind, that the fires have been extinguished thoroughly, and that no articles have been left behind.

Mountaineering

As a rule, mountain climbing in the park is incidental to a camping trip rather than its main objective, for the reason that there are so many splendid peaks which are easily and safely climbed from comfortable base camps. In many of the good camping places well below timberline, visited in the course of an outing, the camper will find himself at such an elevation, and so close to the base of some peak, that it is a simple matter to make the ascent and return to the camp in a single day's trip. Although many peaks rise to an altitude of about thirteen thousand feet above sea-level, no one mountain of the

park stands out in isolation, towering preëminently above its fellows and thus inviting the special attention of the mountaineer. By this it is not to be inferred that the peaks do not stand out from one another sufficiently to command splendid views, for many of them offer magnificent panoramas of forests, lakes, and snow-clad peaks as far as the eye can reach, and are more than worthy of the slight effort usually required to reach them. But instead of rising alone and from a low altitude they are usually found in groups or in a chain, and commence to rise as individual peaks from a high base altitude.

Sierra Characteristics

The Sierra Nevada Range is a huge block of the earth's crust tipped so that it rises very abruptly along its eastern edge, but sloping gently toward the west. The apex of this block forms the crest of the High Sierra which serves as the eastern boundary line of the park. The predominating rock is granite, varied now and then by some other formation such as the metamorphic rock of Mt. Dana and Mt. Gibbs. It is generally characteristic of the peaks that their east and north faces are precipitous, while they slope more gently toward the south and west. Glacial action is strongly in evidence in polished surfaces, carved domes, scoured canyons, and moraines. A few small residual glaciers still remain on the protected northern slopes of some of the higher peaks, where they have cut precipitously walled cirques or amphitheatres well into the mountain sides almost to the very summits.

True alpine conditions of climbing are not often

encountered in the High Sierra unless deliberately sought, and alpen-stocks and ropes are very seldom required. Forests extend well up the slopes of many of the peaks, the timberline generally being about ten thousand or eleven thousand feet. Usually but few large snow fields are found after the middle of July, even at the highest altitudes, but there are often patches in sheltered places or where the drifts have been heavy. Practically all of the principal peaks of the park can be climbed, many of them calling for no special requirements except an early start, endurance, and care to avoid dislodging loose rocks. Some present an element of danger toward the top if the summits are shattered into large blocks difficult to get over or around, and require a steady nerve and a little skillful and careful rock work.

Near-by Yosemite Peaks

Climbing to the points and peaks about the rim of the Valley may hardly be considered mountaineering, since many of them may be reached by well-built trails all or most of the way, but as some of them command excellent views of the Valley or its surroundings they are worthy of mention in this connection. Glacier Point is probably the finest viewpoint of this kind, affording a good bird's-eye view of the eastern end of the floor of the Valley and a splendid panorama of the High Sierra peaks. It is connected with Yosemite Valley by a steep footpath, two horse trails, and an automobile road. Sentinel Dome, about a mile and a half to the southwest, permits of a wider outlook on the high mountain country, while Taft Point, Crocker Point, Stanford Point, and other points along

the beautiful Pohono Trail present intimate views of Yosemite Valley from various angles along its southern rim.

From the north and west the Valley may be viewed to advantage from North Dome, Yosemite Point, Eagle Peak, and El Capitan, the most sweeping panorama being that obtained from Eagle Peak. The most varied view to be had from such a low elevation is that from Sierra Point, a climb of about a thousand feet on a footpath starting from the Vernal Falls Trail opposite the Happy Isles. The Vernal, Nevada, Illilouette, and Upper and Lower Yosemite falls may all be seen from this one spot.

Clouds Rest (9924 feet) and Half Dome (8937 feet) command excellent views of Yosemite Valley from the east, and magnificent panoramas of the High Sierra. There is a horse trail almost to the very summit of Clouds Rest and to within about 1000 feet in elevation of the top of Half Dome. The last four or five hundred feet of this latter climb is quite unique, requiring the use of the arms as well as the legs, there being two parallel steel cable handrails where the surface of the rock is so steep that it is impossible to climb afoot unaided.

High Sierra Peaks

There are dozens of mountains in the Yosemite National Park twelve thousand or thirteen thousand feet in height, and a hundred or two above ten thousand feet, from which wonderful views of the surrounding country are to be had. Only a few of the better known or more accessible ones will be mentioned.

The highest of them, which is also one of the very

finest viewpoints and perhaps the most interesting peak to climb, is Mt. Lyell (13,090 feet). It is usually climbed from a base camp nine thousand feet in elevation, where the Lyell Fork of the Tuolumne River emerges into the long meadow of Lyell Canyon. Making an early start, equipped with tinted glasses to protect the eyes against the snow's glare, and with the face blackened or covered with grease paint to prevent snow-burn, the climb of five and a half miles to the summit is usually made in four or five hours. Following up the west bank of the stream for a little more than two miles, the McClure Fork is crossed at the head of a Cascade at the 10,600-foot level. Generally after the middle of July it is quite free from snow up to this point. Then the rock spurs separating the McClure Fork and Lyell Fork, with stretches of a large snow field in between, are followed for a little over two miles more, veering a little to the southeast to the foot of the Lyell Glacier. This small residual glacier, nestling in an amphitheater which it has cut into the northern face of the peak, is about three quarters of a mile long and twice that in width, and is usually almost entirely covered with deeply pitted snow, making rather laborious climbing. At the head of the glacier, where the moving ice has separated from that clinging to the head wall, is a bergschrund, usually open to a considerable depth for the greater part of the width of the glacier. But it is generally filled with snow directly below Lyell's summit, so that it may be crossed where a long, narrow snow tongue extends well up in between the rugged cliffs. Leaving the snow tongue where it becomes too steep for travel, and climbing up the right hand cliff, the summit is reached after fifteen to thirty minutes of steep rock

climbing where care must be taken not to dislodge loose rocks. At times when there is very little snow covering the glacier, the bergschrund is so wide open that it cannot be crossed at the base of the snow tongue. The ascent can then be made up the rock wall from the extreme easterly end of the glacier. A splendid panorama of snow-clad peaks, innumerable lakes, the sources of several rivers, and broad expanses of forest may be seen in every direction—a glorious spectacle never to be forgotten, and a lesson in the geography of the surrounding country which cannot be equalled in any other way.

The customary base camp for climbing Mt. Dana (13,050 feet) is about four miles below the summit, at the 9700-foot level on the little branch of the Dana Fork of the Tnolumne River which originates in the canyon between Mt. Dana and Mt. Gibbs. These two colorful peaks of metamorphic rock stand out in contrast with the neighboring gray granite peaks. This canyon is followed up to within a few hundred yards of the saddle between these two mountains, at an elevation of 11,500 feet. Although it is rather rough traveling in some places, horses may be ridden to this point. There is then something over a mile of simple, but rather arduous, climbing to the northwest, over heaps of roughly piled and often loosely balanced rocks. To the usually fine scenery witnessed from a mountain top there is here added a view of the interesting Mono Craters and the beautiful blues of Mono Lake to the east, and a display of the extensive Tuolumne Meadows to the west.

Another mountain in the main crest of the range from which a wide outlook may be obtained is Mt. Conness (12,556 feet), a rugged and imposing peak,

but very easily climbed. A horse trail leads nearly to the top from a lovely base camp at Young Lake about four miles to the southwest.

Mt. Hoffmann (10,921 feet) generally climbed from the south, is comparatively isolated and affords a view very well worth while. Cathedral Peak, Unicorn Peak, Echo Peak, and Columbia Finger, a group of peaks to the south of Tuolumne Meadows all approaching eleven thousand feet in elevation, are interesting ascents for experienced climbers. In each case the climb is simple to within a short distance of the top, where the fractured rocks of the summit require a steady nerve and some very careful rock work to avoid a misstep which would be fraught with danger.

Colby Mountain (9700 feet), near the Ten Lakes Basin, commands a view of the Grand Canyon of the Tuolumne, a magnificent gorge which affords a very interesting but strenuous four or five day knapsack trip from Tuolumne Meadows to Hetch Hetchy Valley.

To the south of Merced Lake is Mt. Clark (11,506 feet), presenting a very clear-cut and regular profile against the skyline. It stands out at the end of a long spur, commanding a good view of the southeasterly portion of the park, but it is not very often climbed because rather difficult and far from a convenient base camp. The ascent may be made from the northeast with the final climb along the southeast knife edge.

The highest peak in the Yosemite region, Mt. Ritter (13,156 feet), is just outside of the park boundary, about five miles in a direct line southeast of Mt. Lyell. The climb is made up a steep rock chimney on

the west side, or across the head of the glacier from the southeast if approached from the Shadow Lake side. It is considered one of the more difficult mountain climbs, but has its reward in a wonderful view of the watersheds of the North Fork and Middle Fork of the San Joaquin River.

There are scores of other high mountains, well worthy of the effort of the climber because of the splendid view they afford, and there is hardly a camping place in the park but has at least a little peak near by to tempt the one who has the spirit of the ditty: "The bear went over the mountain to see what he could see."

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MOTORING

IN

YOSEMITE NATIONAL PARK

By

WALLACE B. CURTIS

Associate Manager
Curry Camping Company

MOTORING IN YOSEMITE NATIONAL PARK

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YOSEMITE NATIONAL PARK was first opened to Motor travel late in the 1914 season. At that time the park was under the local government of the War Department, and for the first few months conditions were far from satisfactory. The next year, park control passed to the Department of the Interior and the National Park Service was established, and since then there has been a steady improvement of conditions, until now the motorist enjoys all the freedom that it is practicable to allow.

There are three well-established roads into the Valley, known as the Wawona Road, the Big Oak Flat Road, and the Coulterville Road; and, in addition, the famous Tioga Road cuts directly across the park from Mono Lake westward over the summit of the Sierras. Still another road is in course of construction, and upon its completion it will undoubtedly be the most popular of them all. Starting from Merced it will follow the State Highway to Mariposa, then cut across the mountains to the Merced River Canyon, and thence to El Portal. From there into Yosemite Valley a splendid highway is already constructed. On the entire road there will be no elevation greater than

three thousand feet until one enters the park, so all year round travel will be an easy possibility.

Rules and road maps can be obtained from either the National Park Service Headquarters in Yosemite or at any of the hotels, camps, or lodges, and inasmuch as there are minor changes in these from time to time they will not be taken up here.

Driving over mountain roads is not so dangerous as many people would have one believe, provided that one or two simple rules are always followed. The first of these is, "Always keep your car under full control." Many drivers have the habit of coasting with their gears out of mesh; the risk of such a practice is apparent, so whenever a car is on a down-grade, the gears should be thrown into second or low and compression used as a brake.

The second rule is, "Don't be afraid to shift gears." You may hear a driver boast that he made such and such a grade on "high," but that is merely an admission of poor judgment, for such practice puts an undue strain upon the motor and transmission. Before you start up a grade, decide what gear you are going to use, get up good engine speed, and shift into gear. Shifting gears on any grade is dangerous practice and especially so in mountain driving.

The driver of the car has one thing to keep in mind and that is, that he must keep his eyes on the road and let the rest of the passengers look at the scenery. His car should be equipped with a good loud horn and it should be used frequently.

The principal requisite for good mountain driving is good common sense, and if this is coupled with the following suggestions, no one need have any hesitancy about attempting the trip.

Carburetor Adjustment. While it is true that with higher altitudes the air mixture changes because of the increasing thinness of the air, still it is advisable for the average motorist to leave his carburetor untouched throughout the trip to the Valley. Carburetor adjustment to meet constantly changing air conditions is a matter of expert judgment, and the layman is expected to know nothing about such adjustments. The only place where a carburetor adjustment might prove really necessary is at the summit of the Tioga Road, while motoring to or from the low country. In case of trouble on this road, which seems to be caused by an improper carburetor adjustment, simply give a little more air to the mixture.

Use of Brakes. Come down hill as much as possible on compression, in order to save brakes. Never let your car gather more momentum than can be overcome with the known strength of the brakes. Alternate the use of the brakes, first using the foot brake and then the hand brake, so that one set will not become overheated and wear out.

Use of Gears. Always decide when approaching a hill what gear will carry the car over the grade and then shift into that gear before starting up the hill. In mountain country it is often dangerous to shift gears on a steep hill, and it is always an unnecessary strain on the car.

Always keep the gears in mesh—it insures control of the car. It is now a State and National Park law to keep gears always in mesh on Sierra roads. Never run on high over a steep grade just to test out the power of the motor—it is the worst and most useless strain on the machine on mountain roads.

Tires. Always keep tires up to guaranteed pressure

on a Yosemite trip. Poor brake use, such as sliding the wheels, or slowing up very suddenly just before a rut, will wear out tires prematurely.

The State and National Park law requires that at least one spare tire be carried on the roads of Yosemite National Park.

Radiators. Never try to make a record for small consumption of water on a trip over any of the roads into Yosemite. Such a practice unnecessarily heats up the engine, and thus increases the consumption of gas and oil. Keep the radiator full of water at all times. The water of mountain creeks is usable, but it should be strained through a cloth before using.

Supplies to Carry. Carry an extra supply of oil; it is more essential than gasoline.

Carry a supply of extra bolts and nuts for your specific make of car.

Carry a spare fan belt.

Carry a can of grease and use it freely.

Seeing the Country. Take down the top when you get into the mountains if you want to see some of the most beautiful scenery along the route.

Road Rules to Remember. Always stay on the right side of the road.

Up-hill traffic has the right-of-way, according to State and National Park law.



PHOTO- GRAPHY

IN

YOSEMITE NATIONAL PARK

By

A · C · PILLSBURY

YOSEMITE
CALIFORNIA

PHOTOGRAPHY IN YOSEMITE NATIONAL PARK

BY ARTHUR C. PILLSBURY, YOSEMITE, CALIFORNIA

No souvenir of a vacation can compare with one's pictures. They are more than mere records of the scenery; each has its own associations, and each brings back memories outside the photo itself. We should strive, however, to produce photographs which have an intrinsic worth as pictures—likenesses which express our own impressions to others. In Yosemite Valley attractive views disclose themselves to every side and even the amateur will have no trouble in securing beautiful pictures if he but give a little thought to composition and correct exposures.

Few people realize what an important part light and shade play in the composition of photographs. Under the high noonday sun most pictures are "flat" and lifeless, and it is during the morning and afternoon hours that the photographer gets his best exposures. The Yosemite features change rapidly in this respect from hour to hour during the day, and the following suggestions are offered with the hope that they will help to solve some of the visitor's problems.

From within the Valley itself the surrounding mountains and cliffs appear high and near—consequently you would better point the camera *up* to take their tops. Do not be afraid of distorting them as

you would a tall building if you did the same thing, for in Nature there are no parallel lines so marked as to offend in a picture.

As to lighting, one should remember that no matter how beautiful a subject is at a given time, it is *most* beautiful at some certain hours during the day. Yosemite Falls is a good example. At nine o'clock the sun is casting shadows across its cliffs, and the Falls are very beautiful, but the foreground is more or less in the shadow. By ten the sun is on the foreground and full on the cliffs, but the light is a little "flat" and stays so until about one or half past. After this time the Falls are casting their shadows, and every rocket as it shoots out casts *its* shadow, so they seem to stand out clear cut from the wall. This latter effect increases until two or half past, when the lower half of the Lower Fall is in the shadow. These light and shade effects, in the writer's opinion, make the best picture. After two thirty the change is very rapid and by three o'clock the Falls are almost entirely shaded.

Bridalveil Falls are in the shadow all the morning hours, so close views are not good until one o'clock when the upper half of the Falls is touched by sunshine and veiled by wonderfully luminous mist. This, their best time and condition for posing, continues until two thirty.

El Capitan from "River View" has several lighting effects that are pleasing. From seven to eight in the morning the shadow cast by the granite wall makes a bold picture which is particularly good in enlargements. During the late morning hours the sun beats down on its smooth face without shadows until one o'clock, when the profile begins to stand out, and ridges, quite unnoticed half an hour before, begin to

assume shape and substance; these, the best effects, are of short duration.

At Happy Isles, the Meeting of the Waters, the best time for photographs is from ten to twelve o'clock. Going on up the trail one will find a triangle of sunshine on the lovely Vernal Falls at ten, which continues to light their wonderful outpouring of jewels and color until about eleven; later they are apt to be but a broad white streak in one's picture.

Nevada Falls seems a thing of life between eleven and twelve thirty when its great rockets cast shadows upon the face of the Fall, but when fully lit by the sun it does not picture as well.

Mirror Lake is at its best until, at about eight o'clock, its surface is struck by the sun, and it loses its reflective power. After this time it is disappointing unless the sky holds floating clouds which produce the most beautiful effect of all.

The foregoing remarks are but a few of the many which might be included if space permitted. The writer will be pleased to make further such suggestions to those who will see him personally in Yosemite.

A word about the time of one's exposures. Compared with the smoke-laden atmosphere of cities, the light in Yosemite is much faster and clearer, giving strong negatives and good prints and enlargements. The normal exposure within the Valley should be $\frac{1}{25}$ second at U. S. stop 8. Mirror Lake before sunrise requires about $\frac{1}{5}$ second exposure at U. S. aperture 8, and pictures taken beneath the Big Trees should be given about $\frac{1}{2}$ second with the same opening.

At higher altitudes the atmosphere becomes thinner, with the effect that the sky appears more intensely blue but at the same time becomes darker, the sun's

rays become brighter and hotter, and the shadows become deeper and colder. As we ascend we get less diffused illumination from the atmosphere itself, and less protection from the direct rays of the sun. We will therefore get more contrast in our negatives which are exposed at the higher elevations, and on account of the more intense light the camera should be stopped down to 16 for $\frac{1}{25}$ second exposure.

Distant views require only half as much exposure as near-by subjects. Instead of reducing the exposure the better plan is to diminish the opening so as to admit less light.

If the above suggestions are borne in mind the amateur will find no difficulty in obtaining really good pictures during his Yosemite vacation.

APPENDIX

THE WEATHER CONDITIONS OF YOSEMITE VALLEY

BY ANSEL F. HALL

ONE often reads praises and generalities about Yosemite climate and weather but, so far as the writer knows, no concise statement as to exactly what might be expected at any given time of year has ever been published. The accompanying table has been compiled from the U. S. Weather Bureau daily records for the past eleven years and the data summarized for each month. By examining this table one may determine with fair accuracy the conditions which will be encountered at the time of his visit. The following remarks, however, should be borne in mind.

Temperature. The **Mean Maximum** is the average of the hottest temperatures for each day during the month (generally about 2 P.M.). The **Mean Minimum** is the average of the coldest temperatures for each night during the month (generally about 3 A.M.). The **Mean Temperature** is the average temperature for the entire month. The **Maximum Temperature** is the hottest recorded temperature during the month and the **Minimum** the coldest recorded during the same period. The **Greatest Daily Range** is the greatest temperature change for any twenty-four-hour period during the month. The Mean Maximum and the Mean Temperature show very little variation

between the different years, but the Mean Minimum varies considerably, especially in the late spring and summer months. The Greatest Daily Ranges for the different months fluctuate greatly in different years, sometimes as much as fifteen degrees, so this factor in the table is not as reliable for forecasting temperatures as are the other averages.

Precipitation. Rainfall is a factor which varies extremely in different years in both amount and frequency. The frequency is indicated in the horizontal column headed "Number of Days with .01 inch or more Precipitation"; it must be remembered in this connection that from May to October on days upon which rain *does* fall it is generally as short thunder showers.

Snowfall. Snowfall is the one climatic factor which shows the most variation from year to year. A light snowfall sometimes occurs in October and may be rather definitely expected in November, the first snow in five of the past eleven years having occurred during the latter month; during these two months the snow generally melts quickly. In December, however, one may reasonably expect permanent snow, for the records show that in all but three of the past eleven years Yosemite Valley has had a "white Christmas." The melting of the permanent snow is more definite and may be expected quite regularly between March 15th and 30th.

Clear Days. The number of clear, partly cloudy, and cloudy days per month is surprisingly the same from year to year and these figures in the table will closely approximate actual conditions for any month.

WEATHER REPORT SUMMARY, YOSEMITE, CALIFORNIA—AVERAGE FOR ELEVEN YEARS (1909
TO 1919 INCLUSIVE)

MONTHLY SUMMARY.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
<i>Temperature</i>													
Mean Maximum	44.2	52.0	60.8	69.8	74.3	85.5	91.5	93.2	84.6	71.1	58.2	45.8	69.2
Mean Minimum	21.2	23.8	27.4	32.7	36.7	42.9	48.5	47.2	41.2	28.7	25.4	21.0	33.1
Mean	32.7	37.4	44.2	51.2	55.5	64.2	69.6	70.1	63.6	53.2	41.8	33.4	51.4
Maximum	56.7	64.2	77.2	83.0	90.3	95.0	99.6	100.5	94.9	87.8	73.3	59.2	81.0
Minimum	6.8	11.3	18.6	22.6	26.7	33.2	37.4	36.9	32.1	23.4	16.9	8.4	22.9
Greatest Daily Range	36.0	42.3	48.3	51.3	51.4	52.2	53.7	56.0	55.6	56.4	46.5	39.0	49.1
<i>Precipitation</i>													
Total	8.96	6.00	4.53	1.56	2.39	.40	.23	.28	1.06	1.54	2.94	3.99	Totals 33.88
Greatest in 24 hours	1.94	1.43	1.18	.70	1.18	.16	.12	.17	.58	.72	1.11	1.57	
<i>Snow</i>													
Total snowfall	33.1	58.5	18.7	3.6	Trace	.0	.0	.0	.0	Trace	3.5	16.9	134.3
On ground 15th	11.6	9.3	7.6	Trace	.0	.0	.0	.0	.0	.0	Trace	1.9	
On ground 30th	10.4	13.2	Trace	Trace	.0	.0	.0	.0	.0	.0	Trace	7.4	
<i>Number of Days per Month</i>													
With .01 in. or more precip.	10.8	9.5	8.4	5.5	4.9	2.0	1.1	1.4	2.4	3.6	5.4	5.9	61.
Clear	11.3	11.4	13.8	13.2	18.6	24.8	26.6	25.2	21.8	19.9	16.3	14.2	217.
Partly cloudy	8.1	7.3	8.7	8.9	6.6	2.8	3.0	2.9	4.3	5.4	6.7	6.7	71.
Cloudy	11.6	9.6	8.4	8.8	5.2	2.5	1.4	2.8	4.0	5.7	7.0	10.7	77.

TABLE OF LAKES IN YOSEMITE NATIONAL PARK WITH FISHING NOTES

LAKE.	SPECIES OF TROUT.	FISHING.
Adair Lake	Golden Trout, 1919	?
Arndt Lake	None	No fish
Babcock Lake	Rainbow (Date unknown), Steelhead, 1919	Good
Bearup Lake	Loch Leven (Date unknown)	Fair
Benson Lake	Species unknown, 1897 Loch Leven, 1905 Rainbow, 1905	Good
Bernice Lake	Eastern Brook, 1917 Loch Leven, 1913	Good
Branigan Lake	Rainbow (Date unknown)	Good
Breeze Lake	Loch Leven, 1905 Eastern Brook, 1917 Rainbow, 1917	Poor
Buena Vista Lake	Eastern Brook, 1892, 1908, 1918, 1919 Rainbow, 1892	Excellent
Cathedral Lake	Eastern Brook, 1897, 1915	Poor
Chain o' Lakes (near Fernandez Pass) (3)	Dolly Varden, (Date unknown)	Good
Chiquito Lake ¹	None	No fish
Crescent Lake	Eastern Brook, 1891, 1909, 1911	Poor
Doe Lake	No fish	No fish
Dog Lake	Eastern Brook, 1907, 1915, 1917, 1918, 1919 Rainbow, 1920 Loch Leven, 1920	Good
Dorothy Lake	Rainbow, 1911, 1913	Fair
Echo Lake	Eastern Brook, 1913	Fair
Edith Lake	None	No fish
Edna Lake	Brown Trout, 1905	?
Eleanor Lake	Rainbow, 1878, 1880 Eastern Brook, 1908	Excellent
Elizabeth Lake	Eastern Brook, 1907	Good
Ellery Lake ¹	?	Good
Emeric	Steelhead, 1919	Good
Emigrant Lake ¹	Loch Leven (Date unknown)	Good
Evelyn Lake	Loch Leven, 1913 Rainbow, 1878, 1880 Eastern Brook, 1913	Poor
Fletcher Lake	Eastern Brook, 1897 Loch Leven, 1913	Poor
Flora Lake	None	No fish
Gabriel Lake	Eastern Brook (Date unknown)	No fish
Gaylor Lakes (s)	Rainbow, 1906 Cutthroat (Date unknown)	Good

¹ = Outside Park boundaries.

TABLE OF LAKES IN YOSEMITE NATIONAL PARK WITH
FISHING NOTES—*Continued*

LAKE.	SPECIES OF TROUT.	FISHING.
Givens Lake	Eastern Brook (Date unknown)	No fish
Grant Lakes (2)	Eastern Brook, 1918 Steelhead, 1918	Good
Grouse Lake	Rainbow, 1917	Good
Harden Lake	None	No fish
Harriet Lake	None	No fish
Helen Lake (Near Mt. Starr King)	None	No fish
Helen Lake (Near Kuna Crest)	None	No fish
Hidden Lake	None	No fish
Huckleberry Lake ¹	Loch Leven (Date unknown)	Good
Ireland Lake	Eastern Brook, 1897	Excellent
Irwin Lake	Rainbow, 1912	Fair
Johnson Lake	Rainbow, 1897 Eastern Brook, 1891, 1911, 1917, 1919	Excellent
Kibbie Lake	Rainbow, 1878, 1880	Good
Laurel Lake	Eastern Brook (Date unknown) Rainbow (Date unknown)	Good
Lillian Lake	Rainbow (Date unknown)	Fair
Lost Lake	None	No fish
Lukens Lake	None	No fish
Mary Lake	Rainbow, 1911	Fair
Mattie Lake	None	No fish
May Lake	Eastern Brook, 1908, 1917 Loch Leven, 1908 Rainbow, 1908, 1913	Good
McCabe Lakes (5)	Loch Leven, 1920	?
McGee Lake	Rainbow, 1913 Eastern Brook, 1916, 1917	Poor
Merced Lake	Brown Trout, 1905 Loch Leven, 1905, 1918 Species unknown, 1908	Good
Mildred Lake	Species and date unknown	Good
Miller Lake	Species unknown, 1911	?
Minnow Lake	Eastern Brook, 1897	Good
Murdock Lake	None	No fish
Neall Lake	Species and date unknown	Good
Onion Lake	None	No fish
Ostrander Lake	Rainbow, 1892, 1893, 1899, 1911 Eastern Brook, 1893, 1899 Cutthroat (Date unknown)	Good
Peeler Lake ¹	Cutthroat	Excellent
Rock Island Lake	None	No fish

¹ — Outside Park boundaries.

TABLE OF LAKES IN YOSEMITE NATIONAL PARK WITH
FISHING NOTES—*Continued*

LAKE.	SPECIES OF TROUT.	FISHING.
Rodgers Lake	Rainbow, 1907 Loch Leven, 1907	Excellent
Royal Arch Lake	Eastern Brook, 1897	Excellent
Rutherford Lake ¹	Rainbow (Date unknown) Eastern Brook, 1905	Excellent
Saddlebag Lake ¹	Species and date unknown	Good
Shamrock Lake	None	No fish
Sister Lake	None	No fish
Smedberg Lake	No record	Poor
Snow Lake	None	No fish
Soldier Lake	None	No fish
Spiller Lake	Species unknown, 1875	Poor
Summit Lake ¹	Species and date unknown	Poor
Surprise Lake	None	No fish
Swamp Lake (Near McGill Meadow)	None	No fish
Swamp Lake (Near Gravelly Ford)	None	No fish
Table Lake	None	No fish
Tallulah Lake	None	No fish
Tenaya Lake	Eastern Brook, 1909, 1917, 1918, 1919, 1920 Rainbow, 1911, 1915, 1917, 1918, 1919, 1920 Loch Leven, 1911, 1920 Cutthroat, 1918, 1919 Steelhead, 1919	Fair
Ten Lakes (10)	Eastern Brook, 1908, 1913, 1915, 1918 Loch Leven, 1908 Steelhead, 1918	Good
Tilden Lake	Species unknown, 1905, 1911 Rainbow, 1912	Good
Tioga Lake ¹	Species and date unknown	Good
Twin Lakes	Species and date unknown	?
Vernon Lake	Rainbow, 1878, 1880 Eastern Brook (Date unknown)	Good
Virginia Lake	Rainbow (Date unknown)	Fair
Virginia Lakes ¹	Species and date unknown	Good
Vogelsang Lake	Loch Leven, 1913 Eastern Brook, 1918	None
Washburn Lake	Eastern Brook, 1905 Loch Leven, 1905 Species unknown, 1908	Good
Wilmer Lake	Rainbow (Date unknown) Eastern Brook (Date unknown)	Good

¹ = Outside Park boundaries.

TABLE OF LAKES IN YOSEMITE NATIONAL PARK WITH
FISHING NOTES—*Continued*

LAKE.	SPECIES OF TROUT.	FISHING.
Young Lake	Eastern Brook, 1914 Rainbow, 1914	Good
Unnamed chain of Lakes near Lake Eleanor (4)	Loch Leven, 1911	?
Unnamed lake 1 mi. west of Parsons Peak	Loch Leven, 1913	?
Unnamed lake at the source of Emeric Creek	Cutthroat, 1919 Golden, 1920	?
Unnamed lakes (2) just west of Schofield Peak	Rainbow, 1912	?
Unnamed lake near Vogel- sang Pass	Eastern Brook, 1918	No fishing
Unnamed lakes (2) near Bernice Lake	Eastern Brook, 1917	Good

Besides the lakes listed above (112 in the Park and 10 just outside) the U. S. G. S. "Topographic Map of Yosemite National Park" shows 317 other unnamed lakes—mostly small—within the Park. The total number of lakes within the Park is 429.

TABLE OF STREAMS IN YOSEMITE NATIONAL PARK WITH
FISHING NOTES

STREAM.	SPECIES OF TROUT.	FISHING.
Alder Creek	Eastern Brook, 1891 Loch Leven, 1897 Rainbow (Date unknown)	Fish plentiful but small
Alkali Creek	None	No fishing
Avalanche Creek	None	No fishing
Babcock Creek	Rainbow, 1896 Eastern Brook, 1905	Fair
Big Creek	Species unknown, 1905	?
Big Meadow Creek	None	No fishing
Bishop Creek	Rainbow, 1896	Poor
Bluejay Creek	None	No fishing
Breeze Creek	Rainbow, 1896	Good
Bridalveil Creek	Rainbow, 1892, 1899, 1905 Eastern Brook, 1893, 1899	Good
Buck Creek	None	No fishing
Budd Creek	None	No fishing
Buena Vista Creek	Rainbow (Date unknown)	Good
Camp Creek	None	No fishing

TABLE OF STREAMS IN YOSEMITE NATIONAL PARK WITH
FISHING NOTES—*Continued*

STREAM.	SPECIES OF TROUT.	FISHING.
Cascade Creek	Eastern Brook, 1897	Fish all small
Cathedral Creek	Eastern Brook, 1917 Rainbow, 1920	Plentiful but small
Cherry Creek ¹	Species and date unknown	Good
Chilnualna Creek	Eastern Brook, 1892, 1899 Rainbow, 1892, 1899	Fish plentiful but small
Conness Creek	Rainbow (Date unknown)	Fair
Crane Creek	Rainbow, 1915, 1916, 1917	Fish all small
Dana Fork Tuolumne R.	Rainbow (Date unknown)	Good
Delaney Creek	Rainbow (Date unknown)	Poor
Dingley Creek	Rainbow (Date unknown)	Poor
Eagle Peak Creek	None	No fish
Echo Creek	Eastern Brook, 1905	Good
Eleanor Creek	Species and date unknown	Good
Falls Creek	Rainbow, 1913	Good
Fletcher Creek	E. Brook (Date unknown)	Good
Florence Creek	?	?
Foerster Creek	None	No fish
Frog Creek	Rainbow, 1905	Good
Givens Creek	None	No fish
Gray Creek	None	No fish
Grouse Creek	Rainbow (Date unknown)	Good
Illilouette Creek, near mouth	Cutthroat, 1918	Good
Illilouette Creek, above Valley rim	Eastern Brook, 1893 Rainbow, 1893, 1905	Good
Illilouette Creek, Clark Fork	Rainbow, 1905	Good
Indian Creek, near Chin-quapin	Rainbow (Date unknown)	Fair
Indian Creek, Indian Canyon	None	No fish
Ireland Creek	None	No fish
Jack Main Creek	Rainbow, 1905	Good
Kerrick Creek	Species unknown, 1905 Rainbow, 1906	Good
Kibbie Creek	None	No fishing
Leevining Creek ¹	Species and date unknown	Good
Lilly Creek	None	No fishing
Little Crane Creek	Species and date unknown	Fair
Little Yosemite	Eastern Brook, 1891, 1905 Rainbow, 1891, 1896, 1911, 1912, 1913, 1917	Good
Lyell Fork, Merced R.	Eastern Brook, 1908 Rainbow, 1908	Good

¹ = Outside park boundaries.

TABLE OF STREAMS IN YOSEMITE NATIONAL PARK WITH
FISHING NOTES—*Continued*

STREAM.	SPECIES OF TROUT.	FISHING.
Lyell Fork, Tuolumne River	Eastern Brook, 1879, 1919 Rainbow, 1896, 1915 Cutthroat, 1896 Tahoe Trout, 1896	Good
Matterhorn Creek	Eastern Brook, 1905	Good
Merced River, at El Portal	Eastern Brook, 1918, 1919	Good
at Yosemite Valley	Rainbow, 1909, 1912, 1917 Brown Trout, 1905, 1920 Loch Leven, 1912 Dolly Varden (Date unknown) Steelhead, 1917 Cutthroat, 1918, 1919 Eastern Brook, 1917, 1918, 1919, 1920	Fair
at Little Yosemite	Eastern Brook, 1891, 1905 Rainbow, 1891, 1896, 1911, 1912, 1913, 1917	Good
Merced River, McClure Fork	Eastern Brook, 1905	Good
Merced River, Lyell Fork	Rainbow, 1908 Eastern Brook, 1908	Good
Merced River, South Fork	Rainbow (Date unknown) Brown Trout (Date unknown) Eastern Brook, 1899	Good
at Gravelly Ford	Cutthroat, 1895	Good
near Buck Camp	Eastern Brook, 1899 Rainbow, 1899	Good
Miller Creek	Eastern Brook, 1916	Good
Moss Creek	Rainbow, 1915 Eastern Brook (Date unknown)	Fish plentiful but small
Murphy Creek	Species and date unknown	Fair
North Crane Creek	Species and date unknown	Fish all small
Ottoway Creek	None	No fish
Pigeon Creek	None	No fish
Piute Creek	Rainbow, 1896 Eastern Brook, 1903, 1905	Good
Porcupine Creek	Species unknown, 1897	Fish all small
Rafferty Creek	None	No fishing
Rancheria Creek	Eastern Brook, 1905	Good
Red Creek	None	No fish
Register Creek	None	No fish
Return Creek	Eastern Brook, 1896, 1913	Poor
Ribbon Creek	None	No fish
Rodgers Canyon Cr.	Rainbow (Date unknown)	Good
Rush Creek (Merced)	Rainbow, 1892, 1897 Unknown, 1905	Poor
Sentinel Creek	None	No fishing
Slide Canyon Cr.	None	No fishing

TABLE OF STREAMS IN YOSEMITE NATIONAL PARK WITH
FISHING NOTES—*Continued*

STREAM.	SPECIES OF TROUT.	FISHING.
Smith Creek	Eastern Brook, 1916	Fish all small
Snow Creek	Species and date unknown	Fish all small
Spiller Creek	None	No fishing
Stubblefield Canyon Cr.	None	No fishing
Sunrise Creek	Species and date unknown	Poor
Tamarack Creek	Eastern Brook, 1896, 1920 Rainbow or Cutthroat, 1919	Fish all small
Tenaya Creek in Yosemite Valley	Eastern Brook, 1907 Rainbow, 1909	Fair
Thompson Canyon Cr.	None	No fish
Tilden Canyon Cr.	Species and date unknown	Good
Tiltill Creek	Species unknown, 1897 Eastern Brook, 1905	Fair
Tripple Creek	Eastern Brook, 1907	Good
Tuolumne River at Hetch Hetchy	Tahoe Trout, 1896 Cutthroat, 1896 Rainbow, 1896, 1906 Eastern Brook, 1906	Good
at Conness Creek	Cutthroat, 1896	Good
at Soda Springs	Tahoe, 1895 Loch Leven, 1920 Rainbow, 1896, 1915, 1920	Good
Tuolumne River, Lyell Fork	Tahoe, 1896 Rainbow, 1896, 1915 Eastern Brook, 1897, 1899, 1919 Cutthroat, 1896	Good
Tuolumne River, Dana Fork	Rainbow (Date not known)	Good
Tuolumne River, Middle Fork	Loch Leven, 1897 Eastern Brook, 1906, 1917, 1918, 1919	Good
Tuolumne River, South Fork	Species unknown, 1905 Rainbow, 1899 Eastern Brook, 1906, 1917, 1918, 1919	Good
Virginia Canyon Cr.	Loch Leven, 1920 Rainbow, 1920	?
Wilson Creek	Eastern Brook, 1916	?
Yosemite Creek	Eastern Brook, 1893, 1897, 1917 Rainbow, 1893, 1905 Cutthroat, 1897	Fair

THE IDENTIFICATION OF TREES

In using the following key the trees are eliminated by groups until the species is finally determined. For example: We may first examine the leaves to determine whether they are in bundles or arranged singly on the branchlets; this will eliminate the large group "I" or "II." If the tree falls in group "I" we then determine whether there are 5, 3, 2, or 1 needles in a sheath; this will put the tree in class "A," "B," "C," or "D." If the species falls in class "A" it may be further traced by comparing the characteristics listed under subdivisions "1," "2," and "3"; these will determine the species.

KEY TO THE CONE-BEARING TREES OF
YOSEMITE NATIONAL PARK

(All have needle-like, awl-like, or scale-like leaves)

I.—Leaves in bundles with a sheath around the base
(Pines)

A—Needles in bundles of 5 (**White Pines**)

1—Cone large (12 to 24 in.). Bark red-brown, in large plates, and flaky. Alt. 4000 to 7000.

SUGAR PINE. *Pinus lambertiana*

2—Cone medium (6 to 10 in.). Bark dark gray and in small 5-sided plates. Alt. 7500 to 9500.

WESTERN WHITE PINE. . . . *Pinus monticola*

3—Cone small (about the size of a hen's egg) and hard. Bark white and smooth. Alt. 9000 to 11,000.

WHITE BARK PINE. *Pinus albicaulis*

B—Needles in bundles of 3 (**Yellow pines**)

1—Foliage silver-gray. Small or medium-size tree, generally branching into several main trunks. Cones large (5 to 8 in.), heavy, and armed with stout hooks. Alt. only below 3000.

DIGGER PINE.....*Pinus sabiniana*

2—Foliage green. Tree large and generally with but one main trunk. Bark in large plates and flaky. Alt. 2000 to 8000.

(a)—Cones $2\frac{1}{2}$ to $5\frac{1}{2}$ in. long. Foliage green. Bark yellow-brown.

WESTERN YELLOW PINE..*Pinus ponderosa*

(b)—Cones $5\frac{1}{2}$ to 11 in. long. Foliage blue-green. Bark reddish brown. Generally at higher altitudes than western yellow pine.

JEFFREY PINE.....*Pinus jeffreyi*

C—Needles in bundles of 2. Cones small ($\frac{3}{4}$ to $2\frac{1}{2}$ in.). Small tree (average 70 ft. tall and 2 ft. in dia.). Bark purple-gray and in flakes (not plates).

LODGEPOLE PINE OR "TAMARACK"....

Pinus contorta

D—Needles one in a sheath. Cones small (2 to 3 in.) but seeds large. Tree small. Occurs entirely on eastern slope of Sierra Nevada except one tree in Pate Valley.

PINYON OR NUT PINE..*Pinus monophylla*II.—Leaves **not** in bundles.

A—Leaves linear (*i.e.*, needle-like.) Bark never fibrous or stringy.

I—Fruit a cone.

(a)—Cones erect and occur only near tops of trees. Leaves without petioles (leaf stalks).. (**Firs**)

I—Bark of old trees gray and deeply furrowed.

Needles on lower branches spread flat (2-ranked). Alt. 4000 to 8000.

WHITE FIR.....*Abies concolor*

II—Bark of old trees red and roughened by vertical and transverse fissures. Needles all around branchlets and curved up. Alt. above 7000.

RED FIR.....*Abies magnifica*

(b)—Cones pendent. Leaves with petioles.

I—Cone medium sized (2 to 4 in.) and with trident-shaped bracts sticking from between the scales. Tip of tree erect. Alt. 3000 to 6000.

DOUGLAS FIR.....*Pseudotsuga taxifolia*

II—Cone small (1 in.) and without exserted bracts. Tip of tree drooping. Alt. only above 8500.

MOUNTAIN HEMLOCK..*Tsuga mertensiana*

2—Fruit a drupe (like a plum) with a kernel much like a nutmeg when dried. Needles sharp-pointed and two-ranked. Small tree occurring in the canyon of the Merced only below Cascade Falls.

CALIFORNIA NUTMEG. *Tumion californicum*

B—Leaves scale-like or awl-like. Bark of all older trees fibrous and stringy.

1—Fruit a blue berry (really a modified cone). Leaves scale-like and closely pressed around twigs. Spray round. Inhabits open rocky sites above 7000 ft. alt.

WESTERN JUNIPER...*Juniperus occidentalis*

2—Fruit a true cone.

(a)—Cones medium size (1½ to 3 in.) and with many scales. Needles of lower branches awl-like. Mature trees very large. Occurs only in scattered groves, the nearest of which is 17½ miles from Yosemite.

GIANT SEQUOIA.....*Sequoia gigantea*

(b)—Cones small (1 inch or less) and with only 5 (apparently 3) scales. Needles scale-like and decurrent (*i.e.*, with a portion of their bases fastened along the branchlets). Trees up to 5 feet in diameter. Spray flattened. Occurs abundantly in Yosemite Valley and up to 8000 ft. alt.

INCENSE CEDAR.....*Libocedrus decurrens*

MAP OF YOSEMITE NATIONAL PARK

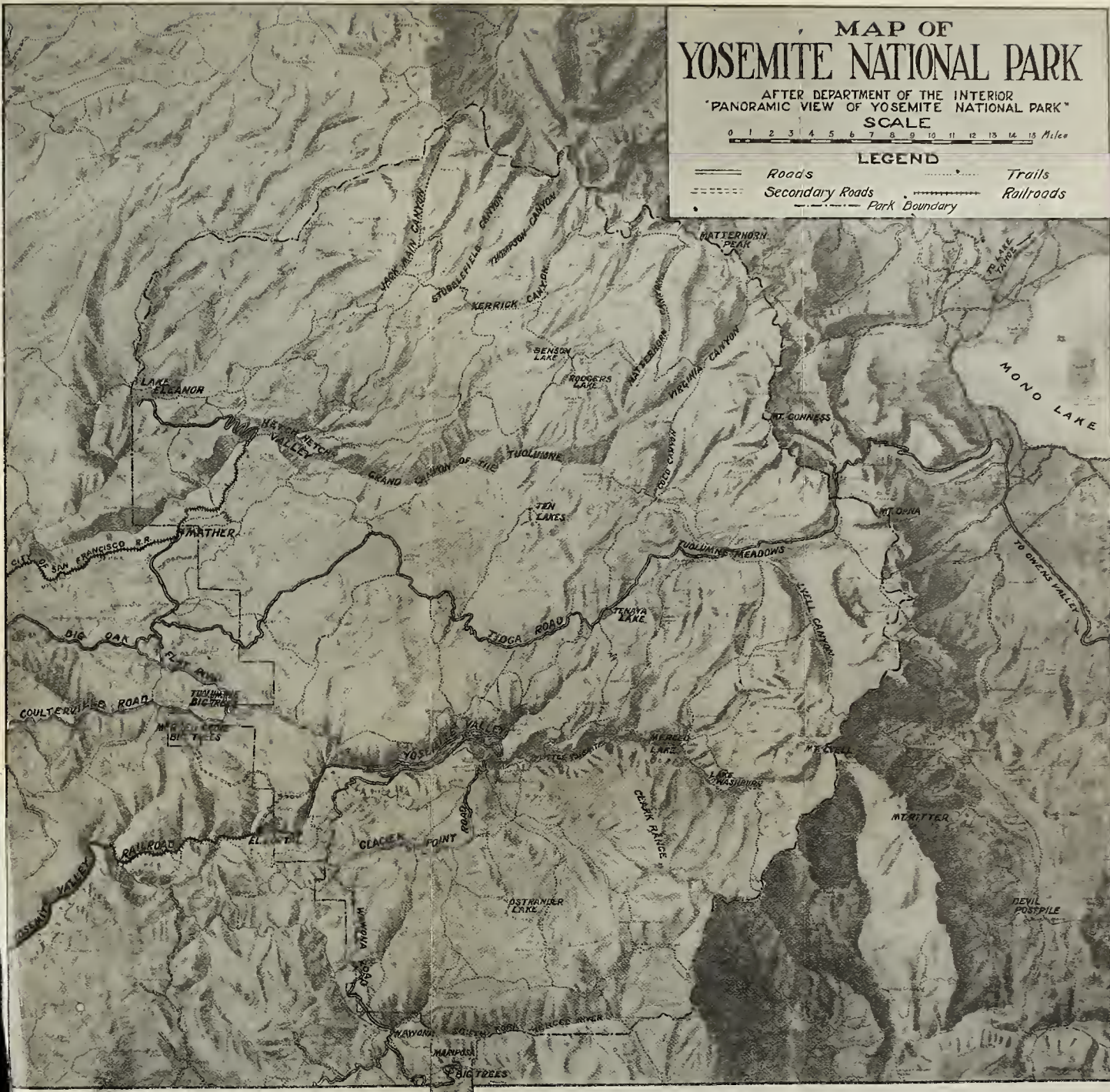
AFTER DEPARTMENT OF THE INTERIOR
"PANORAMIC VIEW OF YOSEMITE NATIONAL PARK"

SCALE

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 Miles

LEGEND

	Roads		Trails
	Secondary Roads		Railroads
	Park Boundary		





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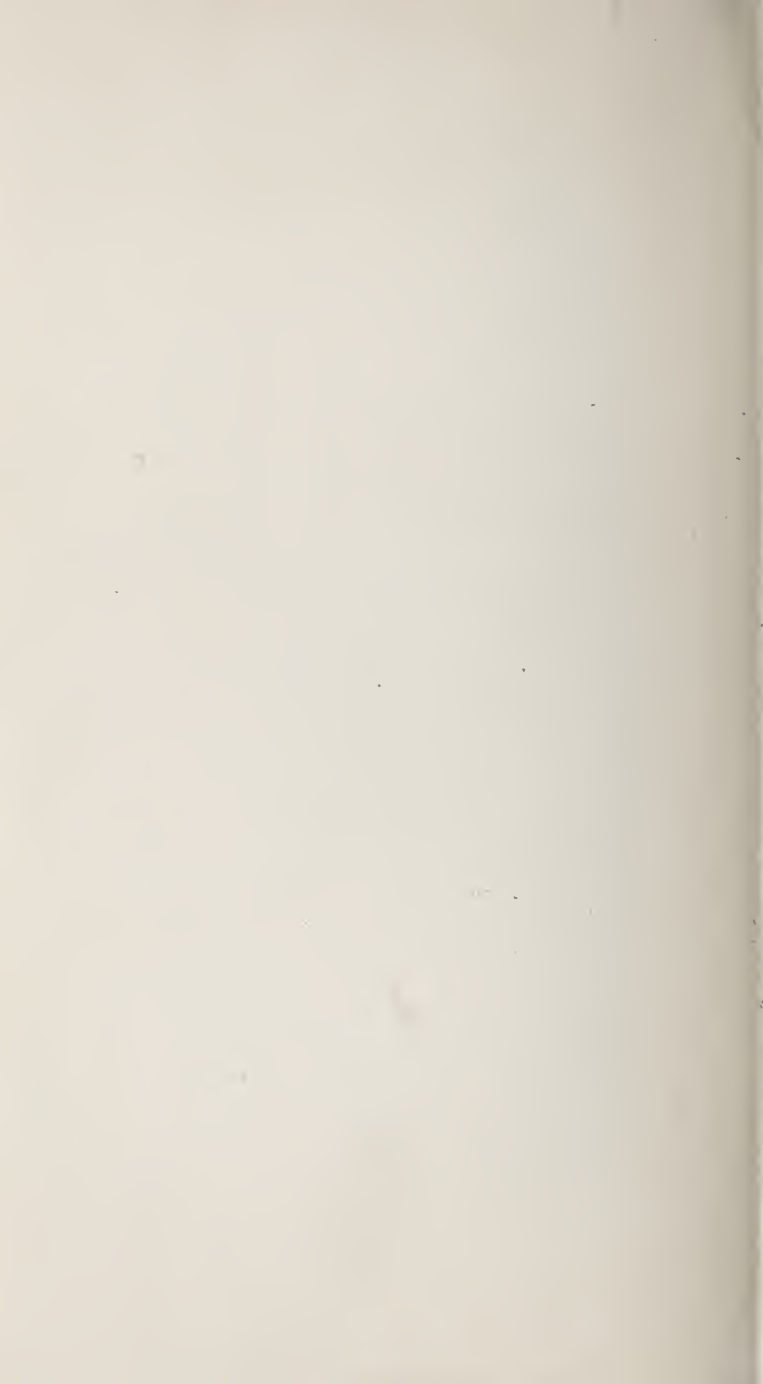
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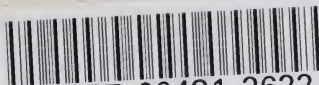
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